

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E - REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT**

**NOVEMBER 2000**



**For**

**U.S. Environmental Protection Agency  
Region 2  
and  
U.S. Army Corps of Engineers  
Kansas City District**

**Book 2 of 2  
Tables, Figures and Plates**

**TAMS Consultants, Inc.  
Menzie-Cura & Associates, Inc.**

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
TABLE OF CONTENTS .....	i
LIST OF TABLES .....	xiii
LIST OF FIGURES .....	xxv
LIST OF PLATES .....	xxvi
EXECUTIVE SUMMARY .....	ES-1
 1.0 INTRODUCTION .....	 1
1.1 Purpose of Report .....	1
1.2 Site History .....	2
1.2.1 Summary of PCB Sources to the Upper and Lower Hudson River .....	4
1.2.2 Summary of Phase 2 Geochemical Analyses .....	5
1.2.3 Extent of Contamination in the Upper Hudson River .....	5
1.2.3.1 PCBs in Sediment .....	5
1.2.3.2 PCBs in the Water Column .....	6
1.2.3.3 PCBs in Fish .....	7
1.3 Data Sources .....	8
1.4 Technical Approach and Ecological Assessment in the Superfund Process ....	10
1.5 Report Organization .....	11
 2.0 PROBLEM FORMULATION .....	 15
2.1 Site Characterization .....	15
2.1.1 Habitat Descriptions .....	16
2.1.1.1 Upper Hudson River Habitats .....	16
2.1.1.2 Lower Hudson River Habitats .....	17
2.1.2 Hudson River Natural History .....	21
2.1.3 Threatened and Endangered Species .....	24
2.1.4 Significant Habitats .....	26
2.1.5 Human Use of the River .....	27
2.2 Contaminants of Concern .....	28
2.3 Conceptual Model .....	30
2.3.1 Exposure Pathways in the Hudson River Ecosystem .....	31
2.3.1.1 Processes That Govern PCB Distributions in the Environment .	31
2.3.1.2 Biological Fate and Transport Processes .....	32
2.3.1.3 Spatial and Temporal Issues in Congener-specific Uptake .....	36
2.3.2 Ecosystems of the Hudson River .....	37

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
2.3.3 Aquatic Exposure Pathways . . . . .	38
2.3.4 Terrestrial Exposure Pathways . . . . .	39
2.4 Assessment Endpoints . . . . .	40
2.5 Measurement Endpoints . . . . .	41
2.6 Representative Receptors . . . . .	50
2.6.1 Macroinvertebrate Communities . . . . .	51
2.6.2 Fish Receptors . . . . .	51
2.6.3 Avian Receptors . . . . .	52
2.6.4 Mammalian Receptors . . . . .	53
3.0 EXPOSURE ASSESSMENT . . . . .	55
3.1 Quantifying PCB Mixtures and TEQs . . . . .	56
3.1.1 Quantifying PCB Mixtures as Tri+ PCBs . . . . .	58
3.1.2 Quantifying Toxic Equivalencies (TEQ) . . . . .	58
3.2 Estimating Current and Future Exposures . . . . .	61
3.2.1 Upper Hudson River Models . . . . .	61
3.2.2 Lower Hudson River Models . . . . .	62
3.2.2.1 Use of the Farley Models . . . . .	63
3.2.2.2 Estimation of Striped Bass Body Burdens in the Lower Hudson . . . . .	64
3.3 Exposure Concentrations in Water and Sediments . . . . .	65
3.3.1 Measured Concentrations in Water and Sediments . . . . .	65
3.3.2 Modeled Concentrations in Water and Sediments . . . . .	66
3.3.3 Estimating Future Baseline TEQ Concentrations . . . . .	66
3.4 Exposure to Benthic Invertebrates . . . . .	67
3.4.1 Observed Benthic Invertebrate Concentrations . . . . .	67
3.4.2 Modeled Benthic Invertebrate Concentrations . . . . .	68
3.5 Exposure to Fish . . . . .	68
3.5.1 Observed Fish Concentrations . . . . .	69
3.5.2 Modeled Fish Concentrations . . . . .	70
3.6 Exposure to Avian Wildlife . . . . .	71
3.6.1 Measured Concentrations in Birds . . . . .	71
3.6.2 Avian Exposure Models . . . . .	71
3.6.2.1 Surface Water Ingestion Pathway . . . . .	73
3.6.2.2 Incidental Sediment Ingestion Pathway . . . . .	73
3.6.2.3 Dietary Exposure Pathway . . . . .	75

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
3.6.2.4 Behavioral and Temporal Modifying Factors Relating to Exposure .....	79
3.6.2.5 Biomagnification Factors for Predicting Egg Concentrations ...	79
3.6.3 Exposure Estimates for Avian Wildlife on a Total (Tri+) PCB Basis ...	80
3.6.4 Exposure Estimates for Avian Wildlife on a TEQ Basis .....	81
3.7 Exposure to Mammalian Wildlife .....	82
3.7.1 Observed Mammalian Concentrations .....	82
3.7.2 Mammalian Wildlife Exposure Models .....	83
3.7.2.1 Surface Water Ingestion Pathway .....	83
3.7.2.2 Incidental Sediment Ingestion Pathway .....	83
3.7.2.3 Dietary Exposure Pathway .....	84
3.7.2.4 Behavioral and Temporal Modifying Factors Relating to Exposure .....	87
3.7.3 Exposure Estimates for Mammalian Wildlife on a Total (Tri+) PCB Basis .....	87
3.7.4 Exposure Estimates for Mammalian Wildlife on a TEQ Basis .....	88
3.8 Uncertainty and Sensitivity in Exposure .....	89
3.9 Examination of Exposure Pathways Based on Congener Patterns .....	89
3.9.1 Identifying Aroclor Patterns for Use in the Toxicity Assessment .....	92
3.9.2 Determining the Relative Importance of Water, Sediment, and Dietary Exposures .....	94
4.0 EFFECTS ASSESSMENT .....	97
4.1 Polychlorinated Biphenyl Structure and Toxicity .....	97
4.1.1 Structure-Function Relationships of PCBs .....	97
4.1.2 Metabolic Activation and Toxicity of PCBs .....	98
4.1.3 Estimating the Ecological Effects of PCBs .....	99
4.2 Selection of Measures of Effects .....	101
4.2.1 Methodology Used to Derive TRVs .....	103
4.2.2 Selection of TRVs for Benthic Invertebrates .....	106
4.2.3 Selection of TRVs for Fish .....	106
4.2.3.1 Pumpkinseed ( <i>Lepomis gibbosus</i> ) .....	107
4.2.3.2 Spottail Shiner ( <i>Notropis hudsonius</i> ) .....	104
4.2.3.3 Brown Bullhead ( <i>Ictalurus nebulosus</i> ) .....	112
4.2.3.4 Yellow Perch ( <i>Perca flavescens</i> ) .....	114

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
4.2.3.5 White Perch ( <i>Morone americana</i> ) . . . . .	117
4.2.3.6 Largemouth Bass ( <i>Micropterus salmoides</i> ) . . . . .	120
4.2.3.7 Striped Bass ( <i>Morone saxatilis</i> ) . . . . .	122
4.2.4 Selection of TRVs for Avian Receptors . . . . .	125
4.2.4.1 Tree Swallow ( <i>Tachycineta bicolor</i> ) . . . . .	125
4.2.4.2 Mallard ( <i>Anas platyrhynchos</i> ) . . . . .	130
4.2.4.3 Belted Kingfisher ( <i>Ceryle alcyon</i> ) . . . . .	134
4.2.4.4 Great Blue Heron ( <i>Ardea herodias</i> ) . . . . .	138
4.2.4.5 Bald Eagle ( <i>Haliaeetus leucocephalus</i> ) . . . . .	142
4.2.5 Selection of TRVs for Mammalian Receptors . . . . .	145
4.2.5.1 Little Brown Bat ( <i>Myotis lucifugus</i> ) . . . . .	145
4.2.5.2 Raccoon ( <i>Procyon lotor</i> ) . . . . .	147
4.2.5.3 Mink ( <i>Mustela vison</i> ) . . . . .	149
4.2.5.4 River Otter ( <i>Lutra canadensis</i> ) . . . . .	151
4.3 Dose-Response Functions from the Literature . . . . .	154
 5.0 RISK CHARACTERIZATION . . . . .	 155
5.1 Evaluation of Assessment Endpoint: Sustainability of a Benthic Invertebrate Community That Can Serve as a Food Source for Local Fish for Local Fish and Wildlife . . . . .	   156
5.1.1 Does the Benthic Community Structure Reflect the Influence of PCBs? . . . . .	 156
5.1.1.1 Measurement Endpoint: TI Pool (Upper Hudson River) Benthic Invertebrate Community Analysis . . . . .	 156
5.1.1.2 Measurement Endpoint: Lower Hudson Benthic Invertebrate Community Analysis . . . . .	 158
5.1.2 Do Measured and Modeled Sediment Concentrations Exceed Guidelines?. . . . .	 159
5.1.2.1 Measurement Endpoint: Comparison of Sediment PCB Concentrations to Guidelines . . . . .	 159
5.2 Evaluation of Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth, and Reproduction) of Local Fish Populations . . . . .	 161
5.2.1 Do Measured and/or Modeled Total and TEQ-Based PCB Body Burdens in Local Fish Species Exceed Benchmarks for Adverse Effects on Fish Reproduction? . . . . .	  161

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
5.2.1.1 Measurement Endpoint: Comparison of Measured and Modeled Total PCB Fish Body Burdens to Toxicity Reference Values for Forage Fish .....	161
5.2.1.2 Measurement Endpoint: Comparison of Modeled TEQ Fish Body Burdens to Toxicity Reference Values for Forage Fish	161
5.2.1.3 Measurement Endpoint: Comparison of Modeled Total PCB Fish Body Burdens to Toxicity Reference Values for Brown Bullhead .....	162
5.2.1.4 Measurement Endpoint: Comparison of Modeled TEQ Basis Fish Body Burdens to Toxicity Reference Values for Brown Bullhead .....	162
5.2.1.5 Measurement Endpoint: Comparison of Observed Total PCB and TEQ Basis Fish Body Burdens to Toxicity Reference Values for Largemouth Bass and Brown Bullhead .....	162
5.2.1.6 Measurement Endpoint: Comparison of Measured Total and TEQ-based PCB Fish Body Burdens to Toxicity Reference Values for White and Yellow Perch Based on NYSDEC Data .....	163
5.2.1.7 Measurement Endpoint: Comparison of Modeled Total PCB Fish Body Burdens to Toxicity Reference Values for White and Yellow Perch for the Period 1993 - 2018 .....	163
5.2.1.8 Measurement Endpoint: Comparison of Modeled TEQ Basis Body Burdens to Toxicity Reference Values for White and Yellow Perch for the Period 1993 - 2018 .....	164
5.2.1.9 Measurement Endpoint: Comparison of Modeled Tri+ PCB Fish Body Burdens to Toxicity Reference Values for Large-mouth Bass for the Period 1993 - 2018 .....	164
5.2.1.10 Measurement Endpoint: Comparison of Modeled TEQ Based Fish Body Burdens to Toxicity Reference Values for Largemouth Bass for the Period 1993 - 2018 .....	164
5.2.1.11 Measurement Endpoint: Comparison of Observed Striped Bass Concentrations to Toxicity Reference Values on a Total (Tri+) and TEQ PCB Basis .....	164
5.2.1.12 Measurement Endpoint: Comparison of Modeled Striped Bass Concentrations to Toxicity Reference Values on a Total (Tri+) and TEQ PCB Basis .....	165

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
5.2.2 Do Measured and Modeled PCB Water Concentrations Exceed Appropriate Criteria and/or Guidelines for the Protection of Wildlife? .....	165
5.2.2.1 Measurement Endpoint: Comparison of Water Column Concentrations of PCBs to Criteria .....	165
5.2.3 Do Measured and Modeled Sediment Concentrations Exceed Appropriate Criteria and/or Guidelines for the Protection of Aquatic Life and Wildlife? .....	165
5.2.3.1 Measurement Endpoint: Comparison of Sediment PCB Concentrations to Guidelines .....	165
5.2.4 What Do the Available Field-Based Observations Suggest About the Health of Local Fish Populations? .....	166
5.2.4.1 Measurement Endpoint: Evidence from Field Studies .....	166
5.3 Evaluation of Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth, and Reproduction) of Hudson River Insectivorous Birds ( as Represented by the Tree Swallow) .....	168
5.3.1 Do Measured and Modeled Total and TEQ-Based PCB Dietary Doses to Insectivorous Birds and Egg Concentrations Exceed Benchmarks for Adverse Effects on Reproduction? .....	168
5.3.1.1 Measurement Endpoint: Modeled Dietary Doses of Total PCBs ( <i>i.e.</i> , Tri+) to Insectivorous Birds (Tree Swallow) and Predicted Egg Concentrations Using 1993 Data .....	168
5.3.1.2 Measurement Endpoint: Modeled Dietary Doses on a Tri+ PCB Basis to Insectivorous Birds (Tree Swallow) for the Period 1993 - 2018 .....	169
5.3.1.3 Measurement Endpoint: Predicted Egg Concentrations on a Tri+ PCB Basis to Insectivorous Birds (Tree Swallow) for the Period 1993 - 2018 .....	169
5.3.1.4 Measurement Endpoint: Modeled Dietary Doses of PCBs and Predicted Egg Concentrations Expressed as TEQ to Insectivorous Birds (Tree Swallow) Based on 1993 Data ...	169
5.3.1.5 Measurement Endpoint: Modeled Dietary Doses of PCBs Expressed as TEQ to Insectivorous Birds (Tree Swallow) for the Period 1993 - 2018 .....	169

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
5.3.1.6 Measurement Endpoint: Predicted Egg Concentrations Expressed as TEQ to Insectivorous Birds (Tree Swallow) for the Period 1993 - 2018 .....	169
5.3.2 Do Measured and Modeled PCB Water Concentrations Exceed Criteria and/or Guidelines for the Protection of Insectivorous Birds/ Wildlife? .....	169
5.3.2.1 Measurement Endpoint: Comparison of Measured and Modeled Water Concentrations to Criteria and/or Guidelines .....	169
5.3.3 What Do the Available Field-Based Observations Suggest About the Health of Local Insectivorous Bird Populations? .....	170
5.3.3.1 Measurement Endpoint: Observational Studies .....	170
5.4 Evaluation of Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth and Reproduction) of Local Waterfowl (as represented by Mallards) .....	171
5.4.1 Do Measured and Modeled Total and TEQ-Based PCB Dietary Doses to Waterfowl and Egg Concentrations Exceed Benchmarks for Adverse Effects on Reproduction? .....	171
5.4.1.1 Measurement Endpoint: Modeled Dietary Doses of PCBs and Predicted Egg Concentrations as Total PCBs to Water- fowl (Mallard Ducks) Based on 1993 Data .....	171
5.4.1.2 Measurement Endpoint: Modeled Dietary Doses of Tri+ PCBs to Waterfowl (Mallard Ducks) for the Period 1993 - 2018 .....	171
5.4.1.3 Measurement Endpoint: Predicted Egg Concentrations of Tri+ PCBs to Waterfowl (Mallard Ducks) for the Period 1993 - 2018 .....	171
5.4.1.4 Measurement Endpoint: Modeled Dietary Doses and Predicted Egg Concentrations of TEQ-Based PCBs to Waterfowl (Mallard Ducks) Using 1993 Data .....	171
5.4.1.5 Measurement Endpoint: Modeled Dietary Doses of TEQ-Based PCBs to Waterfowl (Mallard Ducks) for the Period 1993 - 2018 .....	172



**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
5.4.1.6 Measurement Endpoint: Predicted Egg Concentrations of TEQ-Based PCBs to Waterfowl (Mallard Ducks) for the Period 1993 - 2018 . . . . .	172
5.4.2 Do Measured and Modeled Water Concentrations Exceed Criteria and/or Guidelines for the Protection of Waterfowl/Wildlife? . . . . .	172
5.4.2.1 Measurement Endpoint: Comparison of Measured and Modeled Water Concentrations to Criteria and/or Guidelines . . . . .	172
5.4.3 What Do the Available Field-Based Observations Suggest About the Health of Local Waterfowl Populations? . . . . .	172
5.4.3.1 Measurement Endpoint: Observational Studies . . . . .	172
5.5 Evaluation of Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth, and Reproduction) of Hudson River Piscivorous Bird Species (as represented By the Belted Kingfisher, Great Blue Heron, and Bald Eagle) . . . . .	173
5.5.1 Do Measured and Modeled Total and TEQ-Based PCB Dietary Doses To Piscivorous Birds and Egg Concentrations Exceed Benchmarks for Adverse Effects on Reproduction? . . . . .	173
5.5.1.1 Measurement Endpoint: Modeled Dietary Doses of PCBs and Predicted Egg Concentrations for Total PCBs for Piscivorous Birds (Belted Kingfisher, Great Blue Heron, Bald Eagle) Using 1993 Data . . . . .	173
5.5.1.2 Measurement Endpoint: Modeled Dietary Doses of Total (Tri+) PCBs to Piscivorous Birds (Belted Kingfisher, Great Blue Heron, Bald Eagle) for the Period 1993-2018. . . . .	174
5.5.1.3 Measurement Endpoint: Predicted Egg Concentrations Expressed as Tri+ to Piscivorous Birds (Belted Kingfisher, Great Blue Heron, Bald Eagle) for the Period 1993 - 2018 . . . .	174
5.5.1.4 Measurement Endpoint: Modeled Dietary Doses and Predicted Egg Concentrations of PCBs on a TEQ Basis to Piscivorous Birds (Belted Kingfisher, Great Blue Heron, Bald Eagle) Using 1993 Data . . . . .	175
5.5.1.5 Measurement Endpoint: Modeled Dietary Doses of PCBs Expressed as TEQs to Piscivorous Birds (Belted Kingfisher, Great Blue Heron, Bald Eagle) for the Period 1993 - 2018 . . . .	176

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
5.5.1.6 Measurement Endpoint: Predicted Egg Concentrations of PCBs Expressed as TEQs to Piscivorous Birds (Belted Kingfisher, Great Blue Heron, Bald Eagle) for the Period 1993 - 2018 . . . .	176
5.5.2 Do Measured and Modeled Water Concentrations Exceed Criteria And/or Guidelines for the Protection of Wildlife? . . . . .	177
5.5.2.1 Measurement Endpoint: Comparison of Measured and Modeled Water Concentrations to Criteria and/or Guidelines . .	177
5.5.3 What Do the Available Field-Based Observations Suggest About the Health of Local Piscivorous Bird Populations? . . . . .	177
5.5.3.1 Measurement Endpoint: Observational Studies . . . . .	177
5.6 Evaluation of Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival and Reproduction) of Local Insectivorous Mammals (as Represented by the Little Brown Bat) . . . . .	179
5.6.1 Do Measured and Modeled Total and TEQ-Based PCB Dietary Doses to Insectivorous Mammalian Receptors Exceed Benchmarks for Adverse Effects on Reproduction? . . . . .	179
5.6.1.1 Measurement Endpoint: Modeled Dietary Doses of Tri+ to Insectivorous Mammalian Receptors (Little Brown Bat) Using 1993 Data . . . . .	179
5.6.1.2 Measurement Endpoint: Modeled Dietary Doses of Tri+ to Insectivorous Mammalian Receptors (Little Brown Bat) for the Period 1993 - 2018 . . . . .	179
5.6.1.3 Measurement Endpoint: Modeled Dietary Doses on a TEQ Basis to Insectivorous Mammalian Receptors (Little Brown Bat) Using 1993 Data . . . . .	179
5.6.1.4 Measurement Endpoint: Modeled Dietary Doses on a TEQ Basis to Insectivorous Mammalian Receptors (Little Brown Bat) for the Period 1993 - 2018 . . . . .	180
5.6.2 Do Measured and Modeled Water Concentrations Exceed Criteria and/or Guidelines for the Protection of Wildlife? . . . . .	180
5.6.2.1 Measurement Endpoint: Comparison of Measured and Modeled Water Concentrations to Criteria and/or Guide- lines . . . . .	180
5.6.3 What Do the Available Field-Based Observations Suggest About the Health of Local Insectivorous Mammal Populations? . . . . .	181

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
5.6.3.1 Measurement Endpoint: Observational Studies . . . . .	181
5.7 Evaluation of Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival and Repro- duction) of Local Omnivorous Mammals (as Represented by the Raccoon) . . .	181
5.7.1 Do Measured and Modeled Total and TEQ-Based PCB Dietary Doses to Omnivorous Mammalian Receptors Exceed Benchmarks for Adverse Effects on Reproduction? . . . . .	181
5.7.1.1 Measurement Endpoint: Modeled Dietary Doses of Tri+ to Omnivorous Mammalian Receptors (Raccoon) using 1993 Data . . . . .	181
5.7.1.2 Measurement Endpoint: Modeled Dietary Doses of Tri+ to Omnivorous Mammalian Receptors (Raccoon) for the Period 1993 - 2018 . . . . .	181
5.7.1.3 Measurement Endpoint: Modeled Dietary Doses on a TEQ Basis to Omnivorous Mammalian Receptors (Raccoon) using 1993 Data . . . . .	182
5.7.1.4 Measurement Endpoint: Modeled Dietary Doses on a TEQ Basis to Omnivorous Mammalian Receptors (Raccoon) for the Period 1993 - 2018 . . . . .	182
5.7.2 Do Measured and Modeled Water Concentrations Exceed Criteria and/or Guidelines for the Protection of Omnivorous Mammals/ Wildlife? . . . . .	182
5.7.2.1 Measurement Endpoint: Comparison of Measured and Modeled Water Concentrations to Criteria and/or Guide- lines . . . . .	182
5.7.3 What Do the Available Field-Based Observations Suggest About the Health of Local Omnivorous Mammal Populations? . . . . .	183
5.7.3.1 Measurement Endpoint: Observational Studies . . . . .	183
5.8 Evaluation of Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival and Repro- duction) of Local Piscivorous Mammals (as Represented by the Mink and River Otter) . . . . .	183
5.8.1 Measurement Endpoint: Measured Total PCB Concentrations in the Liver of Piscivorous Mamalian Receptors (Mink, River Otter) . . . . .	183
5.8.1.1 Measurement Endpoint: Modeled Dietary Doses of Tri+ to Piscivorous Mammalian Receptors (Mink, River Otter) using 1993 Data . . . . .	183

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
5.8.1.2 Measurement Endpoint: Modeled Dietary Doses of Tri+ to Piscivorous Mammalian Receptors (Mink, River Otter) for the Period 1993 - 2018 .....	184
5.8.1.3 Measurement Endpoint: Modeled Dietary Doses on a TEQ Basis to Piscivorous Mammalian Receptors (Mink, River Otter) Using 1993 Data .....	185
5.8.1.4 Measurement Endpoint: Modeled Dietary Doses on a TEQ Basis to Piscivorous Mammalian Receptors (Mink, River Otter) for the Period 1993 - 2018 .....	185
5.8.2 Do Measured and Modeled Water Concentrations Exceed Criteria and/or Guidelines for the Protection of Wildlife? .....	186
5.8.2.1 Measurement Endpoint: Comparison of Measured and Modeled Water Concentrations to Criteria and/or Guidelines for the Protection of Wildlife .....	186
5.8.3 What Do the Available Field-Based Observations Suggest About the Health of Local Mammalian Populations? .....	186
5.8.3.1 Measurement Endpoint: Observational Studies .....	186
5.9 Results of the Probabilistic Dose-Response Analysis .....	187
5.9.1 Belted Kingfisher .....	187
5.9.2 Bald Eagle .....	187
5.9.3 Mink .....	188
5.9.4 River Otter .....	188
6.0 UNCERTAINTY ANALYSIS .....	189
6.1 Sampling Error and Representativeness .....	189
6.2 Analysis and Quantitation Uncertainties .....	190
6.2.1 TEQ Quantitation .....	192
6.3 Conceptual Model Uncertainties .....	192
6.4 Toxicological Uncertainties .....	193
6.5 Exposure and Modeling Uncertainties .....	195
6.5.1 Natural Variation and Parameter Error .....	195
6.5.1.1 Food Chain Exposures .....	196
6.5.2 Sensitivity and Uncertainty Analysis for Risk Models .....	201
6.5.3 Model Error .....	202
6.5.3.1 Uncertainty in FISHRAND Model Predictions .....	203

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 1 of 2)

	<u>Page</u>
6.5.3.2 Uncertainty in the Farley Models .....	204
6.6 Summary .....	205
7.0 CONCLUSIONS .....	207
7.1 Assessment Endpoint: Sustainability of a Benthic Invertebrate Community, Which Serves as a Food Source for Local Fish and Wildlife .....	207
7.2 Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth, and Repro- duction) of Local Fish Populations .....	208
7.3 Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth, and Repro- duction) of Local Insectivorous Birds .....	213
7.4 Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth, and Repro- duction) of Local Waterfowl .....	215
7.5 Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth and Repro- duction) of Hudson River Piscivorous Bird Species .....	217
7.6 Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth and Repro- duction) of Local Insectivorous Mammals .....	220
7.7 Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth and Repro- duction) of Local Omnivorous Mammals .....	222
7.8 Assessment Endpoint: Sustainability ( <i>i.e.</i> , Survival, Growth and Repro- duction) of Local Piscivorous Mammals .....	223
7.9 Summary .....	225
REFERENCES .....	227

**PHASE 2 REPORT**  
**FURTHER SITE CHARACTERIZATION AND ANALYSIS**  
**VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT**  
**HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

**LIST OF TABLES:**

- 1-1 Average Fish Tissue Concentrations from 1998 NYSDEC Sampling in the Upper Hudson River, Reported as mg/kg Wet Weight and Converted to a Consistent Estimator of Tri+ PCBs
- 1-2 Average Fish Tissue Concentrations from 1998 NYSDEC Sampling in the Upper Hudson River, Reported as mg/kg-Lipid and Converted to a Consistent Estimator of Tri+ PCBs
- 1-3 Half-Life Comparison of Data Lipid-Based Annual Average PCB Concentrations in Fish
- 2-1 Hudson River Fishes
- 2-2 Typical Fish Aggregations in the Upper Hudson River Estuary (RM 101-153)
- 2-3 Amphibians Potentially Found Along the Hudson River
- 2-4 Reptiles Potentially Found Along the Hudson River
- 2-5 Breeding Birds of the Hudson River
- 2-6 Mammals Potentially Found Along the Hudson River
- 2-7 NYS Rare and Listed Species and Habitats Occurring in the Vicinity of the Hudson River
- 2-8 Hudson River Significant Habitats
- 2-9 Hudson River Significant Habitat Species and Resources
- 2-10 Assessment and Measurement Endpoints
- 2-11 Hudson River Receptor Species
  
- 3-1 Average Proportion of Fish-Based TEQ Congeners Using USEPA 1993 Dataset and USFWS 1995 Dataset
- 3-2 Fraction of Tri+ Chlorinated Congeners Expressed as Toxic Equivalencies (TEQ)
- 3-3 Summary of Conversion for the Di though Hexa Homologues used in the Farley Model (table 3-1 of ERA addendum)
- 3-3a Predicted Annual Tri+ PCBs Loads To The Lower Hudson River
- 3-4 Ratio of Striped Bass to Largemouth Bass Concentrations (table 3-2 of ERA addendum)
- 3-5 Whole Water Concentrations Based on USEPA Phase 2 Dataset
- 3-6 Dry Weight Sediment Concentrations Based on USEPA Phase 2 Dataset
- 3-7 Summary of Tri+ Whole Water Concentrations from the HUDTOX (Upper River) and Farley (Lower River) Models and TEQ-Based Predictions for 1993 - 2018
- 3-8 Summary of Tri+ Sediment Concentrations from the HUDTOX (Upper River) and Farley (Lower River) Models and TEQ-Based Predictions for 1993 - 2018
- 3-9 Summary of Organic Carbon Normalized Tri+ Sediment Concentrations from the HUDTOX (Upper River) and Farley (Lower River) Models and TEQ-Based Predictions for 1993 - 2018
- 3-10 Benthic Invertebrate Concentrations Based on USEPA Phase 2 Dataset

**PHASE 2 REPORT**  
**FURTHER SITE CHARACTERIZATION AND ANALYSIS**  
**VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT**  
**HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 3-11 Summary of Tri+ Benthic Invertebrate Concentrations from the FISHRAND Model and TEQ-Based Predictions for 1993 - 2018
- 3-12 Forage Fish Concentrations Based on USEPA Phase 2 Dataset
- 3-13 Observed Concentrations in PPM for Fish Species for River Miles 113, 152, 168 and 189 from NYSDEC Dataset
- 3-14 Observed Striped Bass Concentrations from NYSDEC for the Hudson River
- 3-15 Largemouth Bass Predicted Tri+ Concentrations for 1993 - 2018
- 3-16 Brown Bullhead Predicted Tri+ Concentrations for 1993 - 2018
- 3-17 White Perch Predicted Tri+ Concentrations for 1993 - 2018
- 3-18 Yellow Perch Predicted Tri+ Concentrations for 1993 - 2018
- 3-19 Striped Bass Predicted Tri+ Concentrations for 1993 - 2018
- 3-20a Observed Avian Total PCB Concentrations
- 3-20b Observed Mammalian Total PCB Concentrations
- 3-21 Exposure Parameters for the Tree Swallow (*Tachycineta bicolor*)
- 3-22 Exposure Parameters for the Mallard (*Anas platyrhynchos*)
- 3-23 Exposure Parameters for the Belted Kingfisher (*Ceryle alcyon*)
- 3-24 Exposure Parameters for Great Blue Heron (*Ardea herodias*)
- 3-25 Exposure Parameters for the Bald Eagle (*Haliaeetus leucocephalus*)
- 3-26 Biomagnification Factors Fish to Bird Egg from Scientific Literature
- 3-26a Ratio of Egg And Chick To Insect and Odonata from Hudson River USFWS Data
- 3-27 Summary of ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Tree Swallow Based on 1993 Data Using Sum of Tri+ Congeners
- 3-28 Summary of ADD<sub>95%UCL</sub> and Egg Concentrations for Female Tree Swallow Based on 1993 Data Using Sum of Tri+ Congeners
- 3-29 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Tree Swallow Based on Tri+ Congeners for Period 1993 - 2018
- 3-30 Summary of Lower River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Tree Swallow Based on Tri+ Congeners for Period 1993 - 2018
- 3-31 Summary of ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Mallard Based on 1993 Data Using Sum of Tri+ Congeners
- 3-32 Summary of ADD<sub>95%UCL</sub> and Egg Concentrations for Female Mallard Based on 1993 Data Using Sum of Tri+ Congeners
- 3-33 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Mallard Based on Tri+ Congeners for Period 1993 - 2018
- 3-34 Summary of Lower River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Mallard Based on Tri+ Congeners for Period 1993 - 2018

**PHASE 2 REPORT**  
**FURTHER SITE CHARACTERIZATION AND ANALYSIS**  
**VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT**  
**HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 3-35 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Belted Kingfisher Based on 1993 Data Using Sum of Tri+ Congeners
- 3-36 Summary of ADD<sub>95%UCL</sub> and Egg Concentrations for Female Belted Kingfisher Based on 1993 Data Using Sum of Tri+ Congeners
- 3-37 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Belted Kingfisher Based on Tri+ Congeners for Period 1993 - 2018
- 3-38 Summary of Lower River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Belted Kingfisher Based on Tri+ Congeners for Period 1993 - 2018
- 3-39 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Great Blue Heron Based on 1993 Data Using Sum of Tri+ Congeners
- 3-40 Summary of ADD<sub>95%UCL</sub> and Egg Concentrations for Female Great Blue Heron Based on 1993 Data Using Sum of Tri+ Congeners
- 3-41 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Great Blue Heron Based on Tri+ Congeners for Period 1993 - 2018
- 3-42 Summary of Lower River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Great Blue Heron Based on Tri+ Congeners for Period 1993 - 2018
- 3-43 Summary of ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Eagle Based on 1993 Data Using Sum of Tri+ Congeners
- 3-44 Summary of ADD<sub>95%UCL</sub> and Egg Concentrations for Female Eagle Based on 1993 Data Using Sum of Tri+ Congeners
- 3-45 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Eagle Based on Tri+ Congeners for Period 1993 - 2018
- 3-46 Summary of Lower River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Eagle Based on Tri+ Congeners for Period 1993 - 2018
- 3-47 Summary of ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Tree Swallow Based on 1993 Data on TEQ Basis
- 3-48 Summary of ADD<sub>95%UCL</sub> and Egg Concentrations for Female Tree Swallow Based on 1993 Data on TEQ Basis
- 3-49 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Tree Swallow for the Period 1993 - 2018 on TEQ Basis
- 3-50 Summary of Lower River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Tree Swallow for the Period 1993 - 2018 on TEQ Basis
- 3-51 Summary of ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Mallard Based on 1993 Data on a TEQ Basis
- 3-52 Summary of ADD<sub>95%UCL</sub> and Egg Concentrations for Female Mallard Based on 1993 Data on a TEQ Basis



**PHASE 2 REPORT**  
**FURTHER SITE CHARACTERIZATION AND ANALYSIS**  
**VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT**  
**HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 3-53 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Mallard on a TEQ Basis for Period 1993 - 2018
- 3-54 Summary of Lower River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Mallard on a TEQ Basis for Period 1993 - 2018
- 3-55 Summary of ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Belted Kingfisher Based on 1993 Data on TEQ Basis
- 3-56 Summary of ADD<sub>95%UCL</sub> and Egg Concentrations for Female Belted Kingfisher Based on 1993 Data on TEQ Basis
- 3-57 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Belted Kingfisher for the Period 1993 - 2018 on TEQ Basis
- 3-58 Summary of Lower River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Belted Kingfisher for the Period 1993 - 2018 on TEQ Basis
- 3-59 Summary of ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Great Blue Heron Based on 1993 Data on TEQ Basis
- 3-60 Summary of ADD<sub>95%UCL</sub> and Egg Concentrations for Female Great Blue Heron Based on 1993 Data on TEQ Basis
- 3-61 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Great Blue Heron for the Period 1993 - 2018 on TEQ Basis
- 3-62 Summary of Lower River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Great Blue Heron for the Period 1993 - 2018 on TEQ Basis
- 3-63 Summary of ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Eagle Based on 1993 Data on TEQ Basis
- 3-64 Summary of ADD<sub>95%UCL</sub> and Egg Concentrations for Female Eagle Based on 1993 Data on TEQ Basis
- 3-65 Summary of Upper River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Eagle for the Period 1993 - 2018 on TEQ Basis
- 3-66 Summary of Lower River ADD<sub>EXPECTED</sub> and Egg Concentrations for Female Eagle for the Period 1993 - 2018 on TEQ Basis
- 3-67 Exposure Parameters for Little Brown Bat (*Myotis lucifugus*)
- 3-68 Exposure Parameters for Raccoon (*Procyon lotor*) use updated addendum table
- 3-69 Exposure Parameters for Mink (*Mustela vison*)
- 3-70 Exposure Parameters for River Otter (*Lutra canadensis*)
- 3-71 Summary of ADD<sub>EXPECTED</sub> for Female Bat Using 1993 Data Based on Tri+ Congeners
- 3-72 Summary of ADD<sub>95%UCL</sub> for Female Bat Using 1993 Data Based on Tri+ Congeners
- 3-73 Summary of Upper River ADD<sub>EXPECTED</sub> for Female Bat Based on Tri+ Predictions for the Period 1993 - 2018

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 3-74 Summary of Lower River ADD<sub>EXPECTED</sub> for Female Bat Based on Tri+ Predictions for the Period 1993 - 2018
- 3-75 Summary of ADD<sub>EXPECTED</sub> for Female Raccoon Using 1993 Data Based on Tri+ Congeners
- 3-76 Summary of ADD<sub>95%UCL</sub> for Female Raccoon Using 1993 Data Based on Tri+ Congeners
- 3-77 Summary of Upper River ADD<sub>EXPECTED</sub> for Female Raccoon Based on Tri+ Predictions for the Period 1993 - 2018
- 3-78 Summary of Lower River ADD<sub>EXPECTED</sub> for Female Raccoon Based on Tri+ Predictions for the Period 1993 - 2018
- 3-79 Summary of ADD<sub>EXPECTED</sub> for Female Mink Using 1993 Data Based on Tri+ Congeners
- 3-80 Summary of ADD<sub>95%UCL</sub> for Female Mink Using 1993 Data Based on Tri+ Congeners
- 3-81 Summary of Upper River ADD<sub>EXPECTED</sub> for Female Mink Based on Tri+ Predictions for the Period 1993 - 2018
- 3-82 Summary of Lower River ADD<sub>EXPECTED</sub> for Female Mink Based on Tri+ Predictions for the Period 1993 - 2018
- 3-83 Summary of ADD<sub>EXPECTED</sub> for Female Otter Using 1993 Data Based on Tri+ Congeners
- 3-84 Summary of ADD<sub>95%UCL</sub> for Female Otter Using 1993 Data Based on Tri+ Congeners
- 3-85 Summary of Upper River ADD<sub>EXPECTED</sub> for Female Otter Based on Tri+ Predictions for the Period 1993 - 2018
- 3-86 Summary of Lower River ADD<sub>EXPECTED</sub> for Female Otter Based on Tri+ Predictions for the Period 1993 - 2018
- 3-87 Summary of ADD<sub>EXPECTED</sub> for Female Bat Using 1993 Data on a TEQ Basis
- 3-88 Summary of ADD<sub>95%UCL</sub> for Female Bat Using 1993 Data on a TEQ Basis
- 3-89 Summary of Upper River ADD<sub>EXPECTED</sub> for Female Bat on a TEQ Basis for the Period 1993 - 2018
- 3-90 Summary of Lower River ADD<sub>EXPECTED</sub> for Female Bat on a TEQ Basis for the Period 1993 - 2018
- 3-91 Summary of ADD<sub>EXPECTED</sub> for Female Raccoon Using 1993 Data on a TEQ Basis
- 3-92 Summary of ADD<sub>95%UCL</sub> for Female Raccoon Using 1993 Data on a TEQ Basis
- 3-93 Summary of Upper River ADD<sub>EXPECTED</sub> for Female Raccoon on a TEQ Basis for the Period 1993 - 2018
- 3-94 Summary of Lower River ADD<sub>EXPECTED</sub> for Female Raccoon on a TEQ Basis for the Period 1993 - 2018
- 3-95 Summary of ADD<sub>EXPECTED</sub> for Female Mink Using 1993 Data on a TEQ Basis
- 3-96 Summary of ADD<sub>95%UCL</sub> for Female Mink Using 1993 Data on a TEQ Basis
- 3-97 Summary of Upper River ADD<sub>EXPECTED</sub> for Female Mink on a TEQ Basis for the Period 1993 - 2018
- 3-98 Summary of Lower River ADD<sub>EXPECTED</sub> for Female Mink on a TEQ Basis for the Period 1993 - 2018
- 3-99 Summary of ADD<sub>EXPECTED</sub> for Female Otter Using 1993 Data on a TEQ Basis
- 3-100 Summary of ADD<sub>95%UCL</sub> for Female Otter Using 1993 Data on a TEQ Basis
- 3-101 Summary of Upper River ADD<sub>EXPECTED</sub> for Female Otter on a TEQ Basis for the Period 1993 - 2018

**PHASE 2 REPORT**  
**FURTHER SITE CHARACTERIZATION AND ANALYSIS**  
**VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT**  
**HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 3-102 Summary of Lower River ADD<sub>EXPECTED</sub> for Female Otter on a TEQ Basis for the Period 1993 - 2018
- 3-103 Summary of Distributions and Distribution Parameters
  
- 4-1 Common Effects of PCB Exposure in Animals
- 4-2 World-Health Organization for Toxic Equivalency Factors (TEFs) for Humans, Mammals, Fish, and Birds
- 4-3 Selected Sediment Screening Guidelines: PCBs
- 4-4 Toxicity Endpoints for Benthic Invertebrates - Effective Concentrations of Total PCBs, Aroclors and Dioxin Toxic Equivalents (TEQs)
- 4-5 Toxicity Endpoints for Fish - Laboratory Studies - Effective Concentrations of Total PCBs and Aroclors
- 4-6 Toxicity Endpoints for Fish - Field Studies - Effective Concentrations of Total PCBs and Aroclors
- 4-7 Toxicity Endpoints for Fish - Laboratory Studies - Effective Concentrations of Dioxin Toxic Equivalents (TEQs)
- 4-8 Toxicity Endpoints for Fish - Field Studies - Effective Concentrations of Dioxin Toxic Equivalents (TEQs)
- 4-9 Toxicity Endpoints for Birds - Laboratory Studies - Effective Dietary Doses of Total PCBs and Aroclors
- 4-10 Toxicity Endpoints for Birds - Field Studies - Effective Dietary Doses of Total PCBs and Aroclors
- 4-11 Toxicity Endpoints for Bird s - Laboratory Studies - Effective Dietary Doses of Dioxin Toxic Equivalents (TEQs)
- 4-12 Toxicity Endpoints for Birds Field Studies - Effective Dietary Doses of Dioxin Toxic Equivalents (TEQs)
- 4-13 Toxicity Endpoints for Bird Eggs - Laboratory Studies - Effective Concentrations of Total PCBs and Aroclors
- 4-14 Toxicity Endpoints for Bird Eggs - Field Studies - Effective Concentrations of Total PCBs and Aroclors
- 4-15 Toxicity Endpoints for Bird Eggs - Laboratory Studies - Effective Concentrations of Dioxin Toxic Equivalents (TEQs)
- 4-16 Toxicity Endpoints for Bird Eggs - Field Studies - Effective Concentrations of Dioxin Toxic Equivalents (TEQs)
- 4-17 Toxicity Endpoints for Other Mammals - Laboratory Studies - Effective Dietary Doses of Total PCBs and Aroclors
- 4-18 Toxicity Endpoints for Other Mammals - Laboratory Studies - Effective Dietary Doses of Dioxin Toxic Equivalents (TEQs)
- 4-19 Toxicity Endpoints for Mink - Laboratory Studies - Effective Dietary Doses of Total PCBs and Aroclors

**PHASE 2 REPORT**  
**FURTHER SITE CHARACTERIZATION AND ANALYSIS**  
**VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT**  
**HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 4-20 Toxicity Endpoints for Mink - Field Studies - Effective Dietary Doses of Total PCBs and Aroclors
- 4-21 Toxicity Endpoints for Mink - Laboratory Studies - Effective Dietary Doses of Dioxin Toxic Equivalents (TEQs)
- 4-22 Toxicity Endpoints for Mink - Field Studies - Effective Dietary Doses of Dioxin Toxic Equivalents (TEQs)
- 4-23 Taxonomy of Studied Organisms
- 4-24 Standard Animal Body Weights and Food Intake Rates
- 4-25a Toxicity Reference Values for Fish - Dietary Doses and Egg Concentrations of Total PCBs and Dioxin Toxic Equivalents (TEQs) Without Uncertainty Factors
- 4-25b Toxicity Reference Values for Fish - Dietary Doses and Egg Concentrations of Total PCBs and Dioxin Toxic Equivalents (TEQs) With Uncertainty Factors
- 4-26a Toxicity Reference Values for Birds - Dietary Doses and Egg Concentrations of Total PCBs and Dioxin Toxic Equivalents (TEQs) Without Uncertainty Factors
- 4-26b Toxicity Reference Values for Birds - Dietary Doses and Egg Concentrations of Total PCBs and Dioxin Toxic Equivalents (TEQs) With Uncertainty Factors
- 4-27a Toxicity Reference Values for Mammals - Dietary Doses of Total PCBs and Dioxin Toxic Equivalents (TEQs) Without Uncertainty Factors
- 4-27b Toxicity Reference Values for Mammals - Dietary Doses of Total PCBs and Dioxin Toxic Equivalents (TEQs) With Uncertainty Factors
  
- 5-1 Benthic Invertebrates Collected at TI Pool Stations
- 5-2 Relative Abundance of Five Dominant Taxonomic Groups at TI Stations
- 5-3 Summary of Infauna and Total Benthos Indices - TI Pool
- 5-4 Relative Percent Abundance of Macroinvertebrates - Lower Hudson River
- 5-5 Summary of Diversity Indices and Abundance Data - Lower Hudson River
- 5-6 Ratio of Observed Sediment Concentrations to Guidelines
- 5-7 Ratio of Predicted Sediment Concentrations to Sediment Guidelines
- 5-8 Ratio of Measured Whole Water Concentrations to Benchmarks
- 5-9 Ratio of Predicted Whole Water Concentrations to Criteria and Benchmarks
- 5-10 Ratio of Measured Forage Fish Concentrations to Toxicity Benchmarks
- 5-11a Ratio of Predicted Pumpkinseed Concentrations to Laboratory-Based NOAEL for Tri+ PCBs - Upper River
- 5-11b Ratio of Predicted Pumpkinseed Concentrations to Laboratory-Based NOAEL for Tri+ PCBs - Lower River
- 5-12a Ratio of Predicted Pumpkinseed Concentrations to Laboratory-Based LOAEL for Tri+ PCBs - Upper River

**PHASE 2 REPORT**  
**FURTHER SITE CHARACTERIZATION AND ANALYSIS**  
**VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT**  
**HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 5-12b Ratio of Predicted Pumpkinseed Concentrations to Laboratory-Based LOAEL for Tri+ PCBs - Lower River
- 5-13a Ratio of Predicted Spottail Shiner Concentrations to Field-Derived NOAEL for Tri+ PCBs - Upper River
- 5-13b Ratio of Predicted Spottail Shiner Concentrations to Field -Derived NOAEL for Tri+ PCBs - Lower River
- 5-14a Ratio of Predicted Spottail Shiner Concentrations to Field-Derived LOAEL for Tri+ PCBs- Upper River
- 5-14b Ratio of Predicted Spottail Shiner Concentrations to Field-Derived LOAEL for Tri+ PCBs - Lower River
- 5-15a Ratio of Predicted Pumpkinseed Concentrations to Laboratory-Derived NOAEL on a TEQ Basis - Upper River
- 5-15b Ratio of Predicted Pumpkinseed Concentrations to Laboratory-Derived NOAEL on a TEQ Basis - Lower River
- 5-16a Ratio of Predicted Spottail Shiner Concentrations to Laboratory-Derived NOAEL on a TEQ Basis - Upper River
- 5-16b Ratio of Predicted Spottail Shiner Concentrations to Laboratory-Derived NOAEL on a TEQ Basis - Lower River
- 5-17a Ratio of Predicted Brown Bullhead Concentrations to Laboratory-Derived NOAEL For Tri+ PCBs - Upper River
- 5-17b Ratio of Predicted Brown Bullhead Concentrations to Laboratory-Derived NOAEL For Tri+ PCBs - Lower River
- 5-18a Ratio of Predicted Brown Bullhead Concentrations to Laboratory-Derived LOAEL For Tri+ PCBs - Upper River
- 5-18b Ratio of Predicted Brown Bullhead Concentrations to Laboratory-Derived LOAEL For Tri+ PCBs - Lower River
- 5-19a Ratio of Predicted Brown Bullhead Concentrations to Laboratory-Derived NOAEL on a TEQ Basis - Upper River
- 5-19b Ratio of Predicted Brown Bullhead Concentrations to Laboratory-Derived NOAEL on a TEQ Basis - Upper River
- 5-20 Ratio of Observed Largemouth Bass and Brown Bullhead Concentrations to Toxicity Benchmarks Using NYSDEC Dataset
- 5-21 Ratio of Observed White Perch and Yellow Perch Concentrations to Toxicity Benchmarks Using NYSDEC Dataset
- 5-22 Ratio of Predicted White Perch Concentrations to Field-Based NOAEL for Tri+ PCBs
- 5-23 Ratio of Predicted White Perch Concentrations to Laboratory-Derived LOAEL for Tri+ PCBs

**PHASE 2 REPORT**  
**FURTHER SITE CHARACTERIZATION AND ANALYSIS**  
**VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT**  
**HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 5-24a Ratio of Predicted Yellow Perch Concentrations to Laboratory-Derived NOAEL for Tri+ PCBs - Upper River
- 5-24b Ratio of Predicted Yellow Perch Concentrations to Laboratory-Derived NOAEL for Tri+ PCBs - Lower River
- 5-25a Ratio of Predicted Yellow Perch Concentrations to Laboratory-Derived LOAEL for Tri+ PCBs - Upper River
- 5-25b Ratio of Predicted Yellow Perch Concentrations to Laboratory-Derived LOAEL for Tri+ PCBs - Lower River
- 5-26 Ratio of Predicted White Perch Concentrations to Laboratory-Derived NOAEL on a TEQ Basis
- 5-27a Ratio of Predicted Yellow Perch Concentrations to Laboratory-Derived NOAEL on a TEQ Basis - Upper River
- 5-27b Ratio of Predicted Yellow Perch Concentrations to Laboratory-Derived NOAEL on a TEQ Basis - Lower River
- 5-28a Ratio of Predicted Largemouth Bass Concentrations to Laboratory-Derived NOAEL For Tri+ PCBs - Upper River
- 5-28b Ratio of Predicted Largemouth Bass Concentrations to Laboratory-Derived NOAEL For Tri+ PCBs - Lower River
- 5-29a Ratio of Predicted Largemouth Bass Concentrations to Laboratory-Derived LOAEL For Tri+ PCBs - Upper River
- 5-29b Ratio of Predicted Largemouth Bass Concentrations to Laboratory-Derived LOAEL For Tri+ PCBs - Lower River
- 5-30a Ratio of Predicted Largemouth Bass Concentrations to Laboratory-Derived NOAEL on a TEQ Basis- Upper River
- 5-30b Ratio of Predicted Largemouth Bass Concentrations to Laboratory-Derived NOAEL on a TEQ Basis- Lower River
- 5-31 Comparison of Measured Striped Bass Concentrations to Toxicity Reference Values
- 5-31a Ratio Of Predicted Striped Bass Concentrations To Tri+ PCB-Based TRVs
- 5-31b Ratio Of Predicted Striped Bass Concentrations To TEQ-Based TRVs
- 5-32 Ratio of Modeled Dietary Dose and Egg Concentrations to Benchmarks Based on 1993 Data for Female Tree Swallow for Tri+ Congeners
- 5-33 Ratio of Modeled Dietary Dose to Benchmarks Based on FISHRAND for Female Tree Swallow Based on the Sum of Tri+ Congeners for the Period 1993 -2018
- 5-34 Ratio of Modeled Egg Concentrations to Benchmarks for Female Tree Swallow Based on the Sum of Tri+ Congeners for the Period 1993 -2018
- 5-35 Ratio of Modeled Dietary Dose and Egg Concentrations to Benchmarks Based on 1993 Data for Female Tree Swallow on TEQ Basis

**PHASE 2 REPORT**  
**FURTHER SITE CHARACTERIZATION AND ANALYSIS**  
**VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT**  
**HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 5-36 Ratio of Modeled Dietary Dose to Benchmarks Based on FISHRAND for Female Tree Swallow Using TEQ for the Period 1993 - 2018
- 5-37 Ratio of Modeled Egg Concentrations to Benchmarks Based on FISHRAND for Female Tree Swallow Using TEQ for the Period 1993 - 2018
- 5-38 Ratio of Modeled Dietary Dose and Egg Concentrations to Benchmarks Based on 1993 Data for Female Mallard for Tri+ Congeners
- 5-39 Ratio of Modeled Dietary Dose to Benchmarks for Female Mallard Based on FISHRAND Results for the Tri+ Congeners
- 5-40 Ratio of Egg Concentrations to Benchmarks for Female Mallard Based on FISHRAND Results for the Tri+ Congeners
- 5-41 Ratio of Modeled Dietary Dose and Egg Concentrations to Benchmarks for Female Mallard Based on 1993 Data on a TEQ Basis
- 5-42 Ratio of Modeled Dietary Dose to Benchmarks for Female Mallard for Period 1993 - 2018 on a TEQ Basis
- 5-43 Ratio of Modeled Egg Concentrations to Benchmarks for Female Mallard for Period 1993 - 2018 on a TEQ Basis
- 5-44 Ratio of Modeled Dietary Dose and Egg Concentrations to Benchmarks Based on 1993 Data for Female Belted Kingfisher for Tri+ Congeners
- 5-45 Ratio of Modeled Dietary Dose and Egg Concentrations to Benchmarks Based on 1993 Data for Female Great Blue Heron for Tri+ Congeners
- 5-46 Ratio of Modeled Dietary Dose and Egg Concentrations to Benchmarks Based on the 1993 Data for Female Bald Eagle for Tri+ Congeners
- 5-47 Ratio of Modeled Dietary Dose to Benchmarks Based on FISHRAND for Female Belted Kingfisher Based on the Sum of Tri+ Congeners for the Period 1993 - 2018
- 5-48 Ratio of Modeled Dietary Dose to Benchmarks Based on FISHRAND for Female Great Blue Heron Based on the Sum of Tri+ Congeners for the Period 1993 - 2018
- 5-49 Ratio of Modeled Dietary Dose to Benchmarks Based on FISHRAND for Female Bald Eagle Based on the Sum of Tri+ Congeners for the Period 1993 - 2018
- 5-50 Ratio of Modeled Egg Concentrations to Benchmarks for Female Belted Kingfisher Based on the Sum of Tri+ Congeners for the Period 1993 - 2018
- 5-51 Ratio of Modeled Egg Concentrations to Benchmarks for Female Great Blue Heron Based on the Sum of Tri+ Congeners for the Period 1993 - 2018
- 5-52 Ratio of Modeled Egg Concentrations to Benchmarks for Female Bald Eagle Based on the Sum of Tri+ Congeners for the Period 1993 - 2018
- 5-53 Ratio of Modeled Dietary Dose and Egg Concentrations to Benchmarks Based on 1993 Data for Female Belted Kingfisher on TEQ Basis

**PHASE 2 REPORT**  
**FURTHER SITE CHARACTERIZATION AND ANALYSIS**  
**VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT**  
**HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 5-54 Ratio of Modeled Dietary Dose and Egg Concentrations to Benchmarks Based on 1993 Data for Female Great Blue Heron on TEQ Basis
- 5-55 Ratio of Modeled Dietary Dose and Egg Concentrations to Benchmarks Based on 1993 Data for Female Bald Eagle on TEQ Basis
- 5-56 Ratio of Modeled Dietary Dose to Benchmarks Based on FISHRAND for Female Belted Kingfisher Using TEQ for the Period 1993 - 2018
- 5-57 Ratio of Modeled Dietary Dose to Benchmarks Based on FISHRAND for Female Great Blue Heron Using TEQ for the Period 1993 - 2018
- 5-58 Ratio of Modeled Dietary Dose to Benchmarks Based on FISHRAND for Female Bald Eagle Using TEQ for the Period 1993 - 2018
- 5-59 Ratio of Modeled Egg Concentrations to Benchmarks Based on FISHRAND for Female Belted Kingfisher Using TEQ for the Period 1993 - 2018
- 5-60 Ratio of Modeled Egg Concentrations to Benchmarks Based on FISHRAND for Female Great Blue Heron Using TEQ for the Period 1993 - 2018
- 5-61 Ratio of Modeled Egg Concentrations to Benchmarks Based on FISHRAND for Female Bald Eagle Using TEQ for the Period 1993 - 2018
- 5-62 Ratio of Modeled Dietary Doses to Benchmarks for Female Bats Based on 1993 Data for the Tri+ Congeners
- 5-63 Ratio of Modeled Dietary Doses to Toxicity Benchmarks for Female Bat for Tri+ Congeners for the Period 1993 - 2018
- 5-64 Ratio of Modeled Dietary Doses to Benchmarks for Female Bat Based on 1993 Data on a TEQ Basis
- 5-65 Ratio of Modeled Dietary Doses to Toxicity Benchmarks for Female Bat on a TEQ Basis for the Period 1993 - 2018
- 5-66 Ratio of Modeled Dietary Doses to Benchmarks for Female Raccoon Based on 1993 Data for the Tri+ Congeners
- 5-67 Ratio of Modeled Dietary Doses to Toxicity Benchmarks for Female Raccoon for Tri+ Congeners for the Period 1993 - 2018
- 5-68 Ratio of Modeled Dietary Doses to Benchmarks for Female Raccoon Based on 1993 Data on a TEQ Basis
- 5-69 Ratio of Modeled Dietary Doses to Toxicity Benchmarks for Female Raccoon on a TEQ Basis for the Period 1993 - 2018
- 5-70 Ratio of Observed Mink and Otter PCB Concentrations to Benchmarks
- 5-71 Ratio of Modeled Dietary Doses to Benchmarks for Female Mink Based on 1993 Data for the Tri+ Congeners
- 5-72 Ratio of Modeled Dietary Doses to Benchmarks for Female Otter Based on 1993 Data for the Tri+ Congeners



**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 5-73 Ratio of Modeled Dietary Doses to Toxicity Benchmarks for Female Mink for Tri+ Congeners for the Period 1993 - 2018
- 5-74 Ratio of Modeled Dietary Dose to Toxicity Benchmarks for Female Otter for Tri+ Congeners for the Period 1993 - 2018
- 5-75 Ratio of Modeled Dietary Doses to Benchmarks for Female Mink Based on 1993 Data on a TEQ Basis
- 5-76 Ratio of Modeled Dietary Doses to Benchmarks for Female Otter Based on 1993 Data on a TEQ Basis
- 5-77 Ratio of Modeled Dietary Doses to Toxicity Benchmarks for Female Mink on a TEQ Basis for the Period 1993 - 2018
- 5-78 Ratio of Modeled Dietary Doses to Toxicity Benchmarks for Female Otter on a TEQ Basis for the Period 1993 - 2018
  
- 6-1 Sensitivity Analysis- Receptor Output
- 6-2 Ranges of Percent Contribution to Variance of Input Parameters
- 6-3 Rank Correlation Sensitivity Analysis Results ( $R^2$ )

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

**LIST OF FIGURES**

- 1-1 Hudson River Drainage Basin and Site Location Map
- 1-2 Baseline Ecological Risk Assessment Upper Hudson River Sampling Stations
- 1-3 Baseline Ecological Risk Assessment Lower Hudson River Sampling Stations
- 1-4 Hudson River ERA Data Sources
- 1-5 Eight-Step Ecological Risk Assessment Process for Superfund Hudson River PCB Reassessment Ecological Risk Assessment
  
- 2-1 Hudson River PCB Reassessment Conceptual Model Diagram Including Floodplain Soils
  
- 3-1 Revised Segments and Regions of the Farley Model for PCBs in Hudson River Estuary and Surrounding Waters
- 3-2 Average Wet Weight PCB Concentrations in Selected Fish Species Based on NYSDEC Data
- 3-3 Average Lipid-Normalized PCB Concentrations in Selected Fish Based on NYSDEC Data
- 3-4 Cumulative Distribution Functions of Exposure for Kingfisher and Eagle
- 3-5 Cumulative Distribution Functions of Exposure for Mink and Otter
- 3-6 Comparison of Congener Mass Fraction Between a Largemouth Bass Sample from RM 190 and Several Aroclor Standards
- 3-7 Comparison of Congener Mass Fraction Between a White Perch Sample from RM 26 and Several Aroclor Standards
- 3-8 Variation of Principal Component 1 with River Mile in Fish and Sediment
- 3-9 Variation of Principal Component 1 with River Mile in Fish and Sediment River Miles 150 to 80
- 3-10 Relationship Between Molecular Weight and River Mile for 1993 Hudson River Samples
- 3-11 Principal Component Results for 1993 and 1995 Fish Samples by Life Stage (Based on 29 Congeners)
- 3-12 Comparison of Congener Mass Fraction in Hudson River Fish and Several Aroclor Standards: Linear Scale
- 3-13 Comparison of Congener Mass Fraction in Hudson River Fish and Several Aroclor Standards: Semilogarithmic
  
- 4-1 Shape of Biphenyl and Substitution Sites
- 4-2 Dose Response Functions for Pheasant and Mink

**PHASE 2 REPORT  
FURTHER SITE CHARACTERIZATION AND ANALYSIS  
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT  
HUDSON RIVER PCBs REASSESSMENT RI/FS**

**CONTENTS**

Volume 2E (Book 2 of 2)

- 5-1 Complete Linkage Clustering - TI Pool
- 5-2 Relative Percent Grain Size Classes - TI Pool
- 5-3 Mean Sediment TOC - TI Pool
- 5-4 Mean Total PCB Concentrations in Sediment - TI Pool
- 5-5 Biomass of Benthic Invertebrates - TI Pool
- 5-6 Relative Percent Grain Size Classes - Lower Hudson River
- 5-7 Mean Sediment TOC - Lower Hudson River
- 5-8 Mean Total PCB Concentration in Sediment - Lower Hudson River
- 5-9 Cumulative Risk Functions for the Belted Kingfisher and Bald Eagle
- 5-10 Cumulative Risk Functions for the Mink and River Otter
  
- 6-1 Predicted Toxicity Quotients from Uncertainty Analysis for the Kingfisher and Kingfisher Egg
- 6-2 Predicted Toxicity Quotients from Uncertainty Analysis for Eagle and Eagle Egg
- 6-3 Predicted Toxicity Quotients from Uncertainty Analysis for Mink and River Otter

**LIST OF PLATES**

- Plate 1 Habitat Map
- Plate 2 Water-Column Sampling Locations in Hudson River

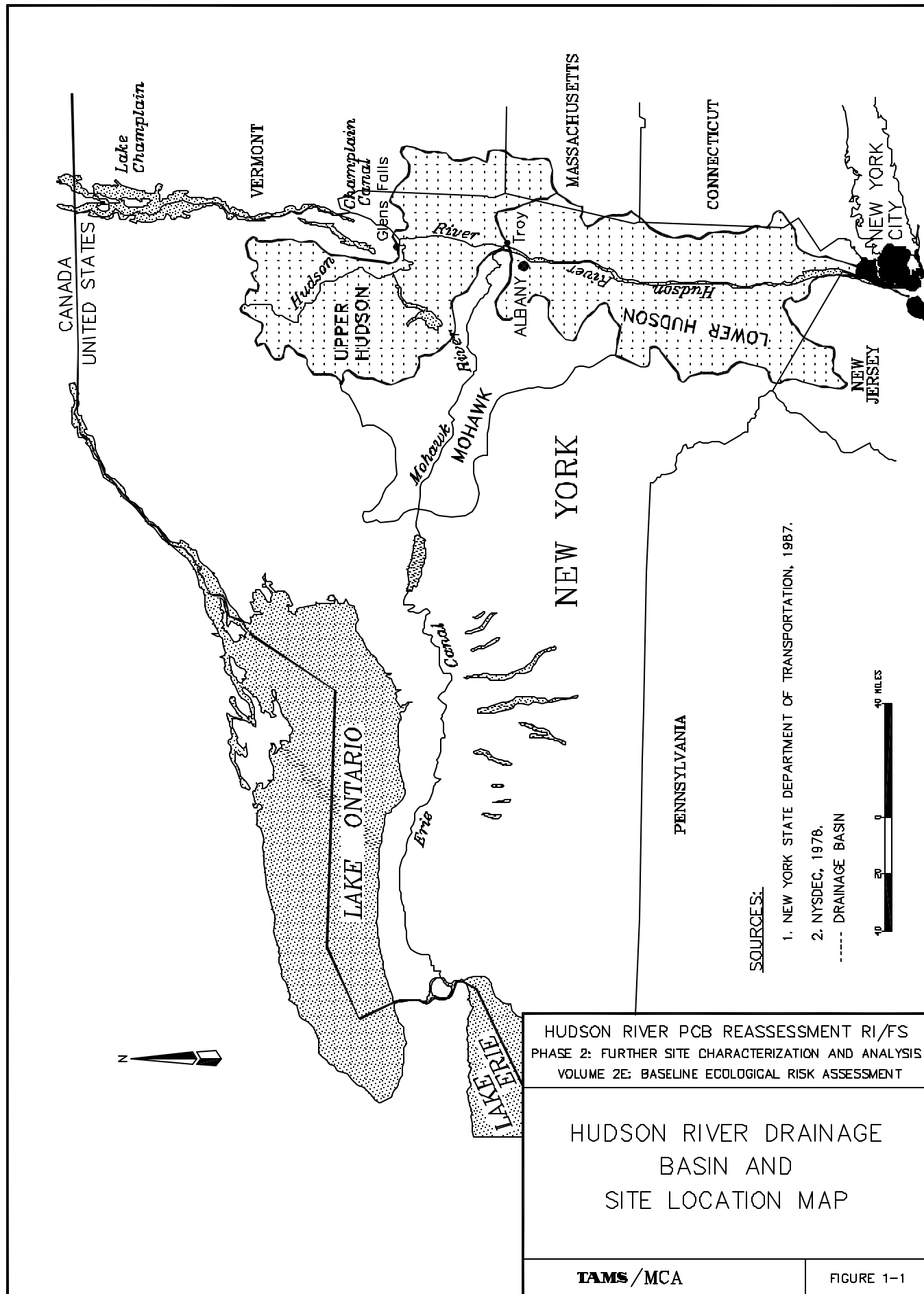


Figure 1-2  
Baseline Ecological Risk Assessment  
Upper Hudson River Sampling Stations

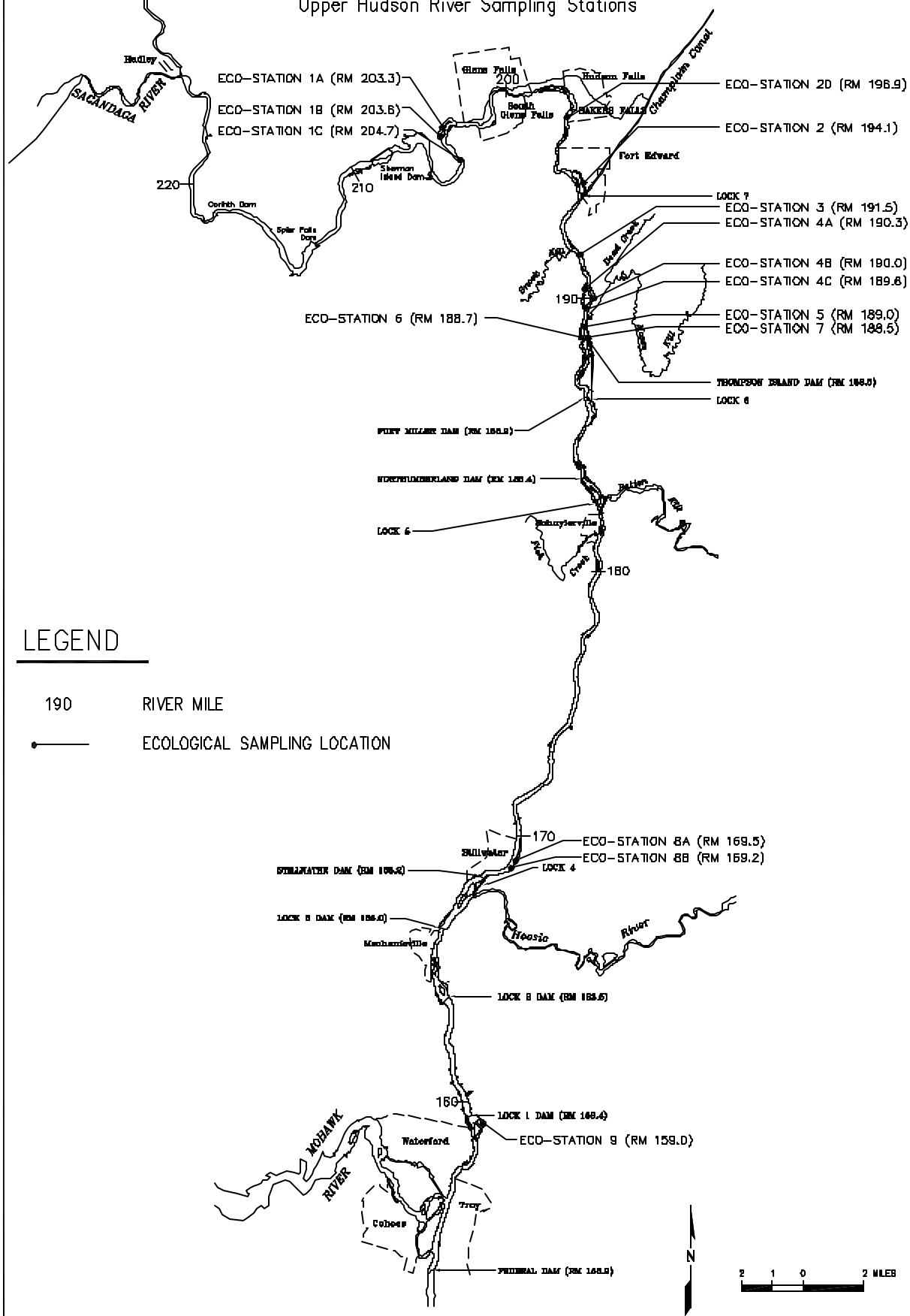
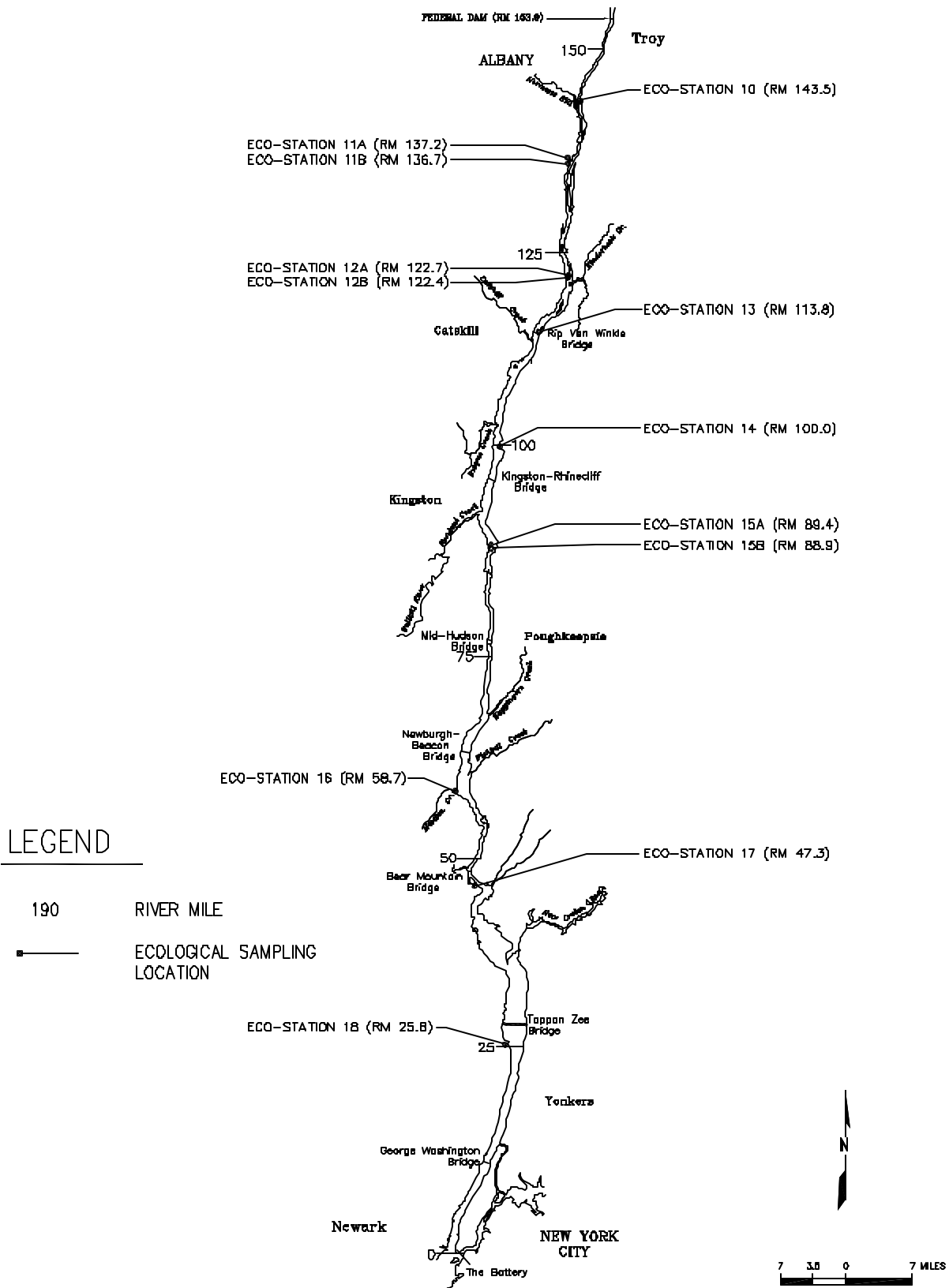
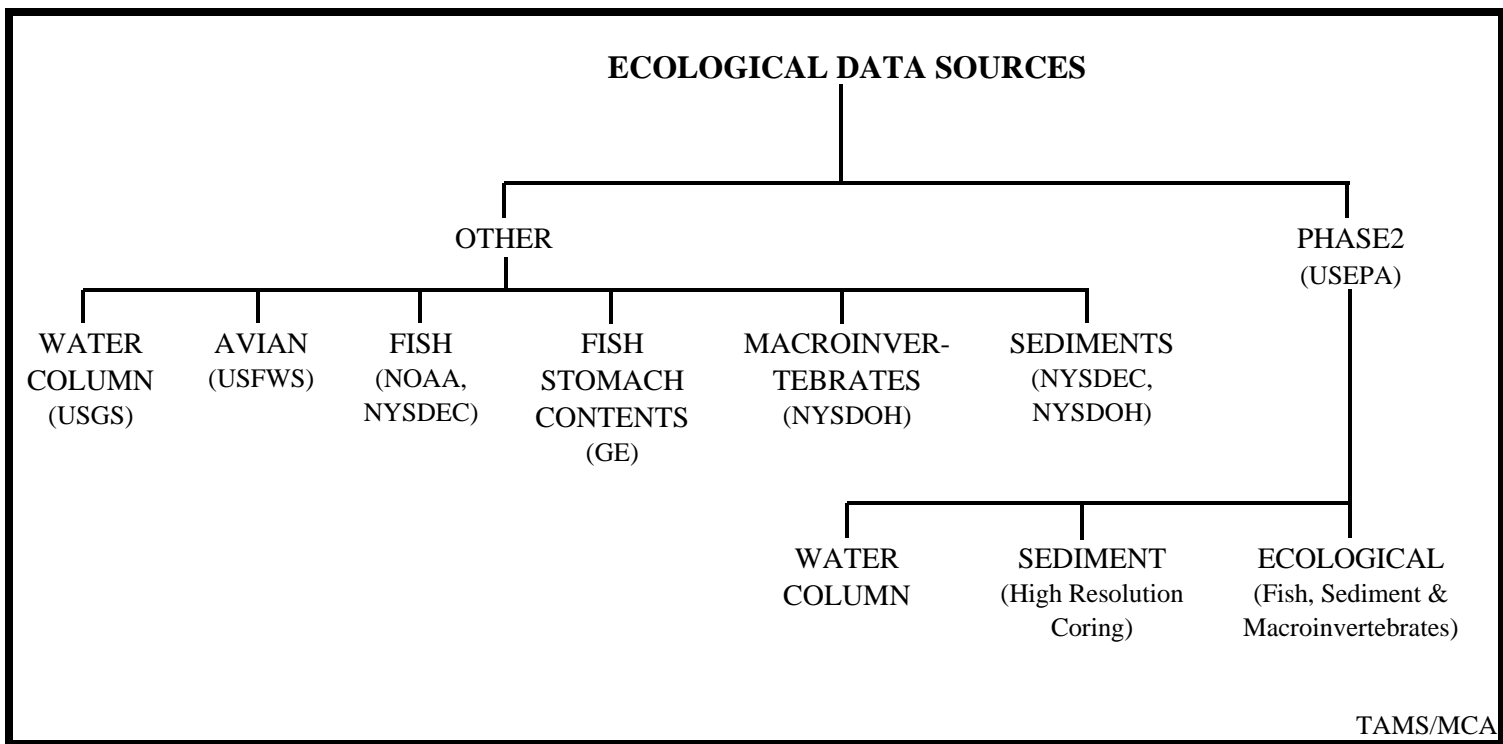


Figure 1-3  
Baseline Ecological Risk Assessment  
Lower Hudson River Sampling Stations





**Figure 1-4**  
**Hudson River ERA Data Sources**

Figure 1-5  
Eight-Step Ecological Risk Assessment Process for Superfund  
Hudson River PCB Reassessment  
Ecological Risk Assessment

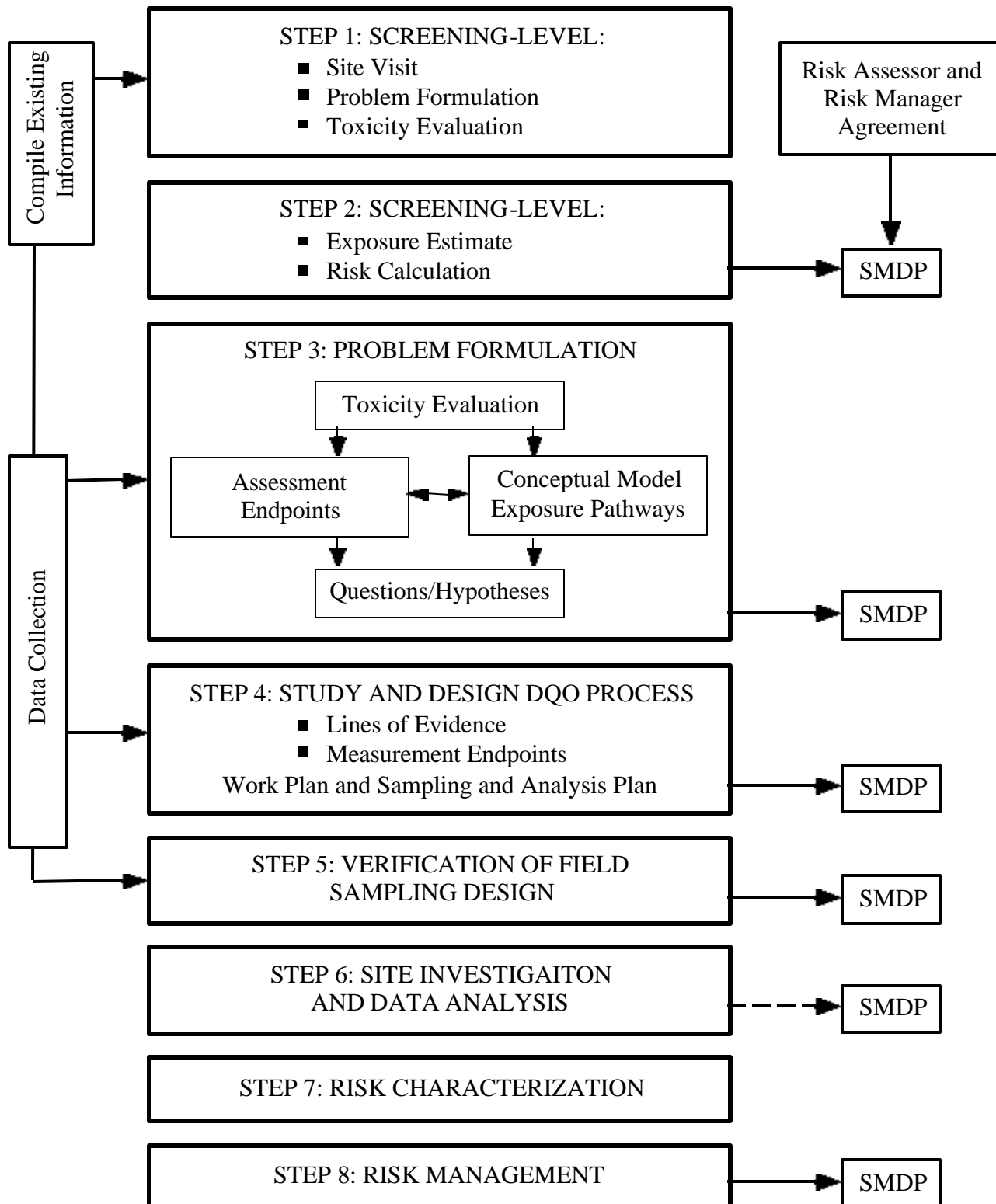
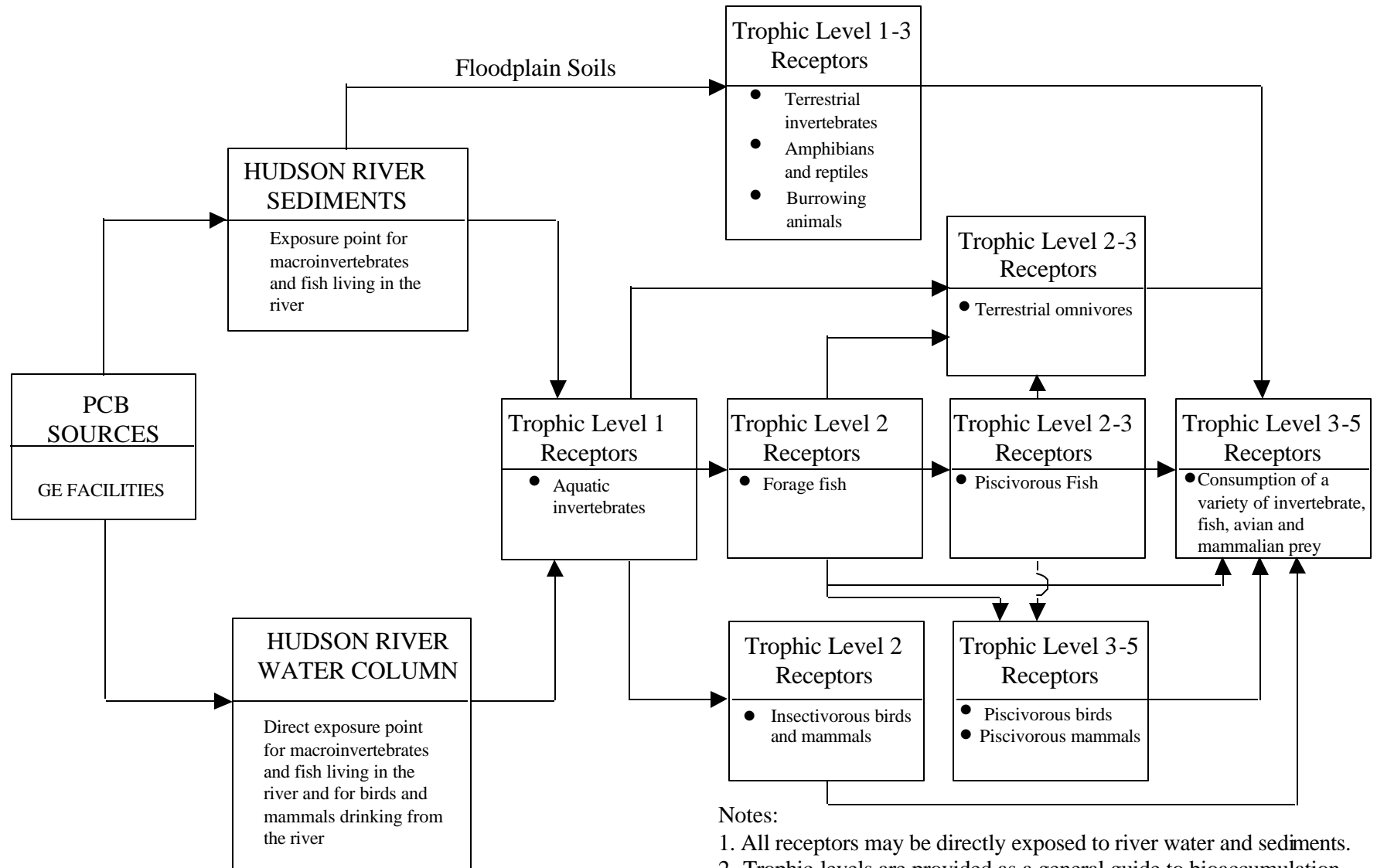


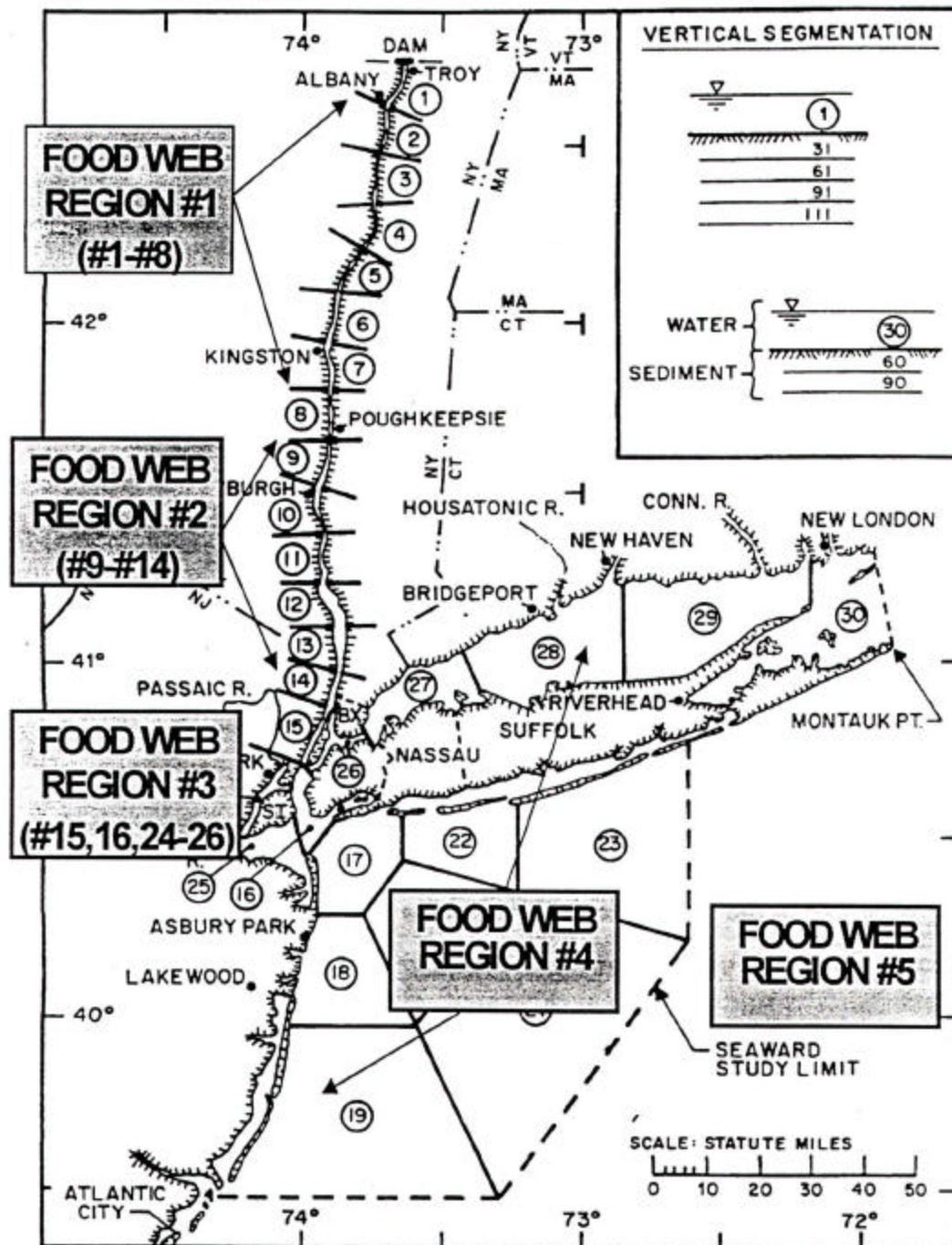


Figure 2-1  
Hudson River PCB Reassessment  
Conceptual Model Diagram Including Floodplain Soils



Notes:

1. All receptors may be directly exposed to river water and sediments.
2. Trophic levels are provided as a general guide to bioaccumulation potential, but vary according to species and food availability.

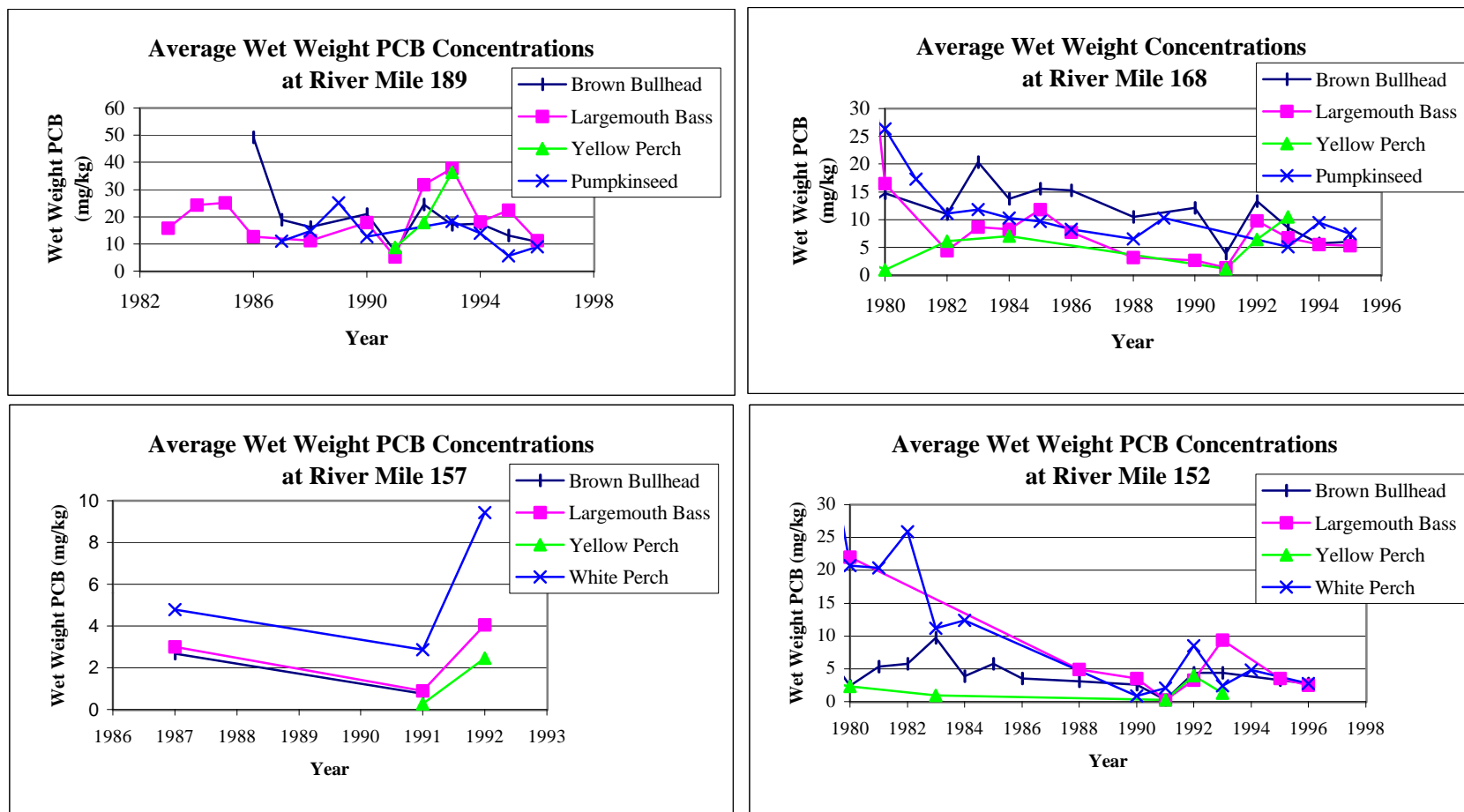


Source: Farley et al., 1999

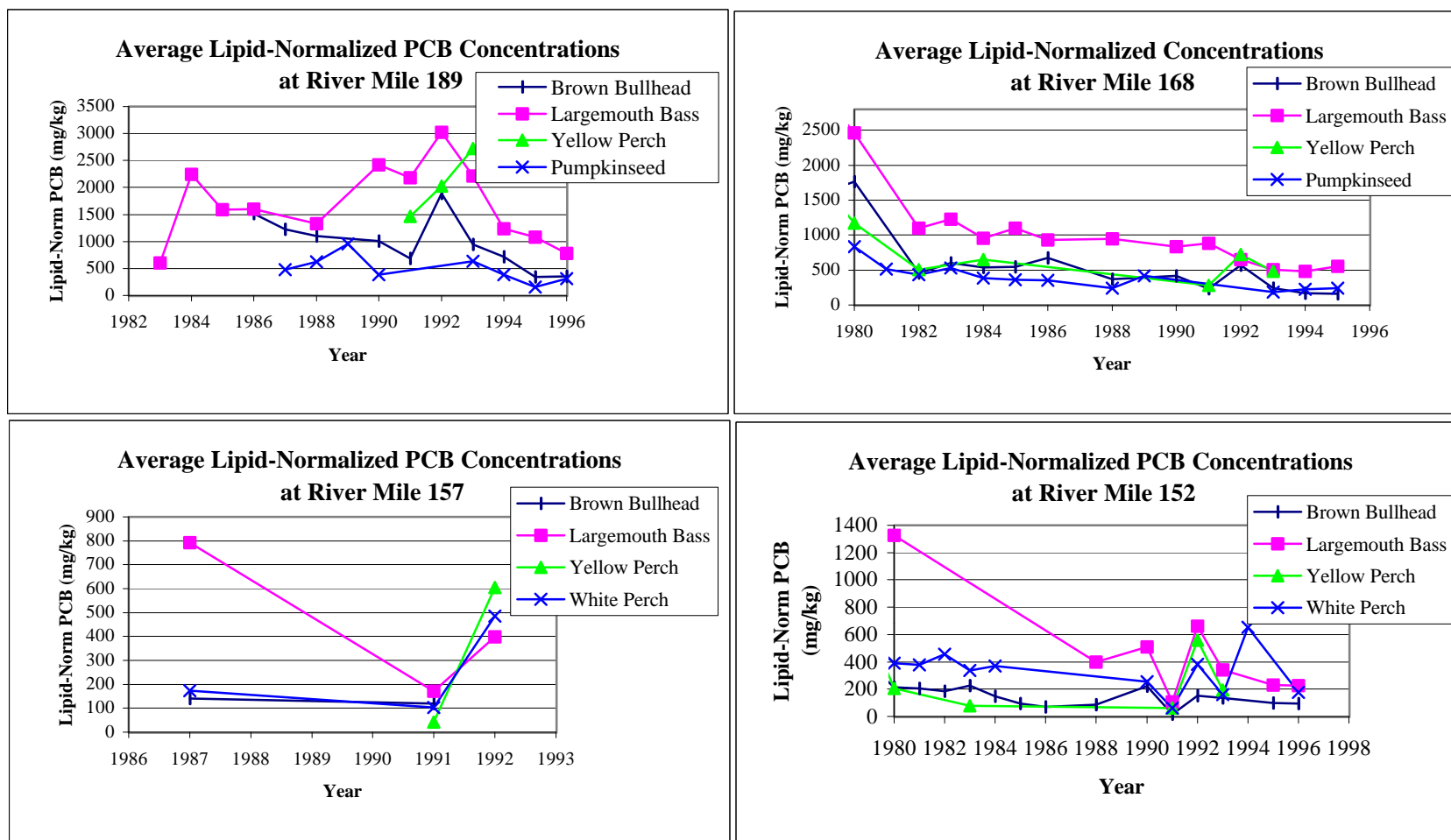
Note: Model segment numbers 1-30 pertain to the Fate and transport model. Model segments are combined into five food web regions for the bioaccumulation model calculations

Figure 3-1  
Revised Segments and Regions of the Farley Model for PCBs in Hudson River Estuary  
and Surrounding Waters

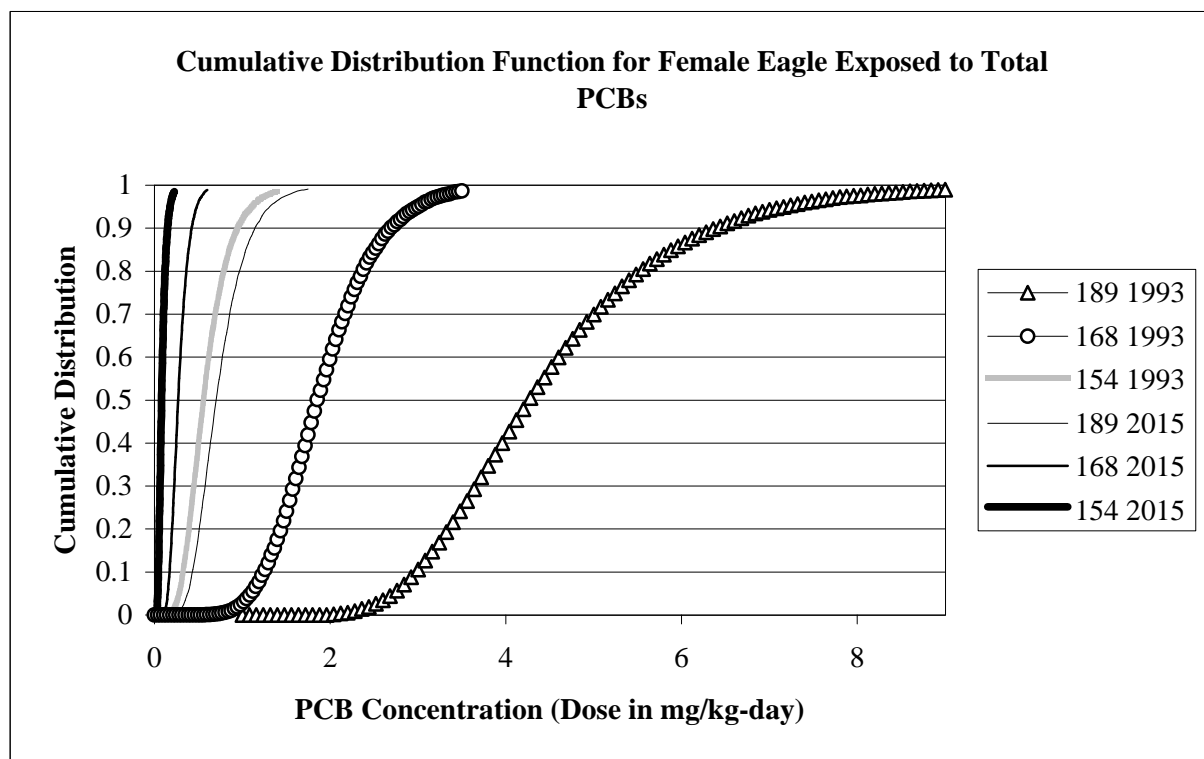
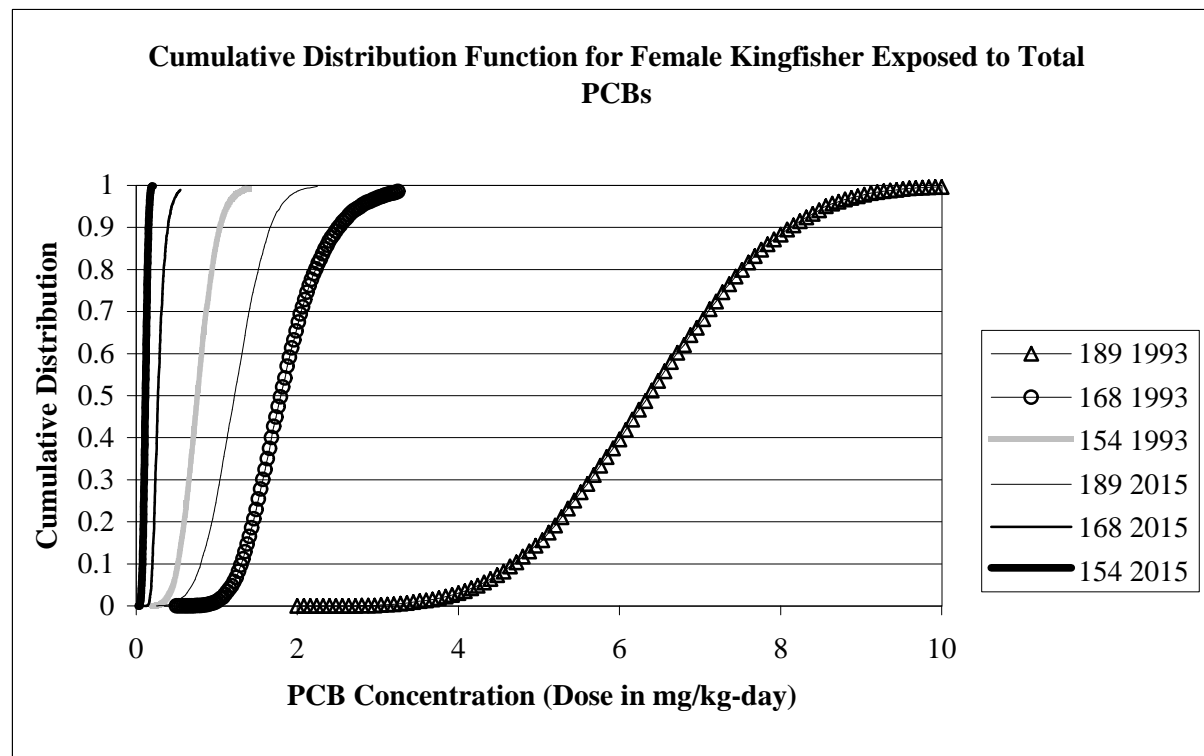
**FIGURE 3-2: AVERAGE WET WEIGHT PCB CONCENTRATIONS IN SELECTED FISH SPECIES BASED ON NYSDEC DATA**



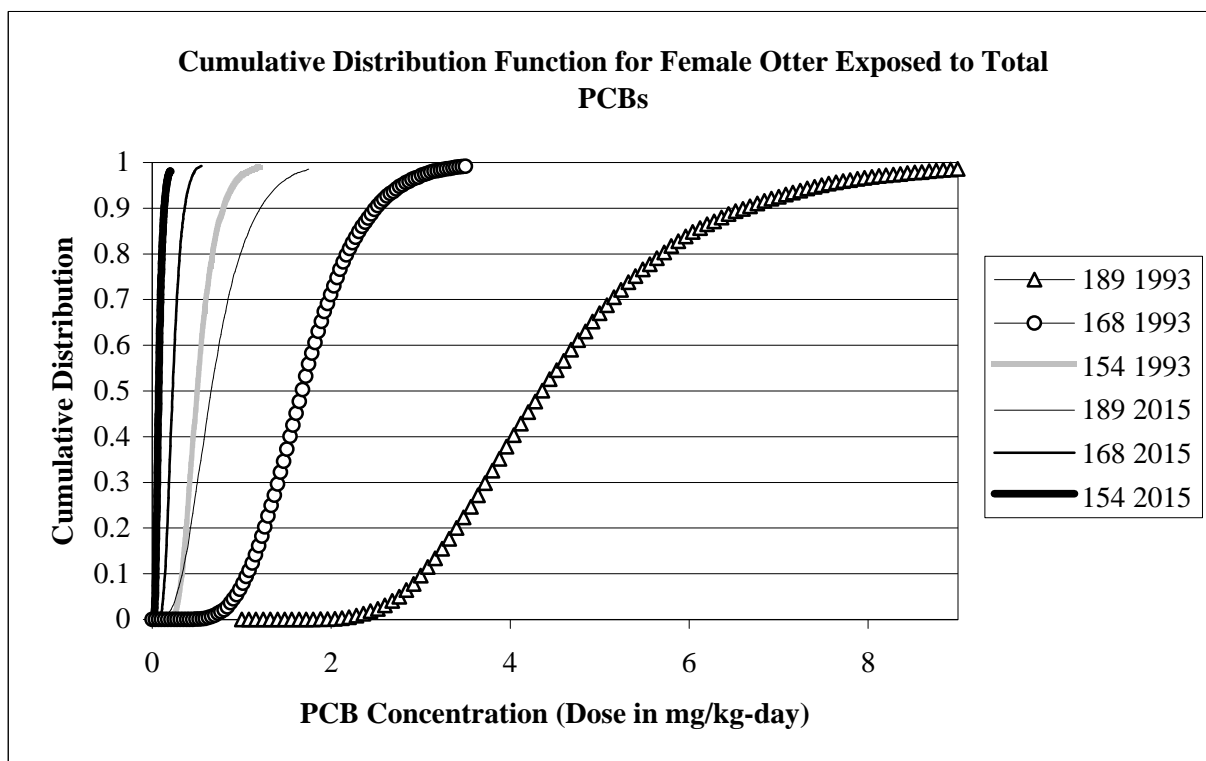
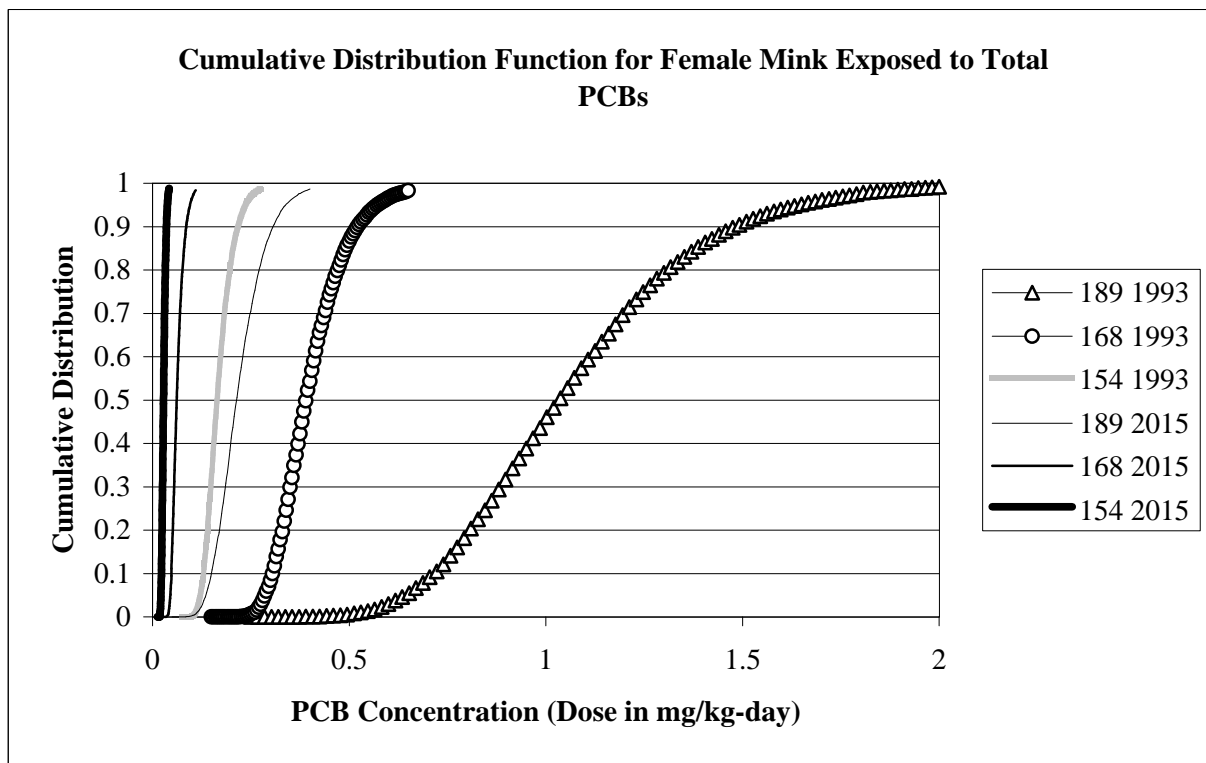
**FIGURE 3-3: AVERAGE LIPID-NORMALIZED PCB CONCENTRATIONS IN SELECTED FISH SPECIES BASED ON NYSDEC DATA**

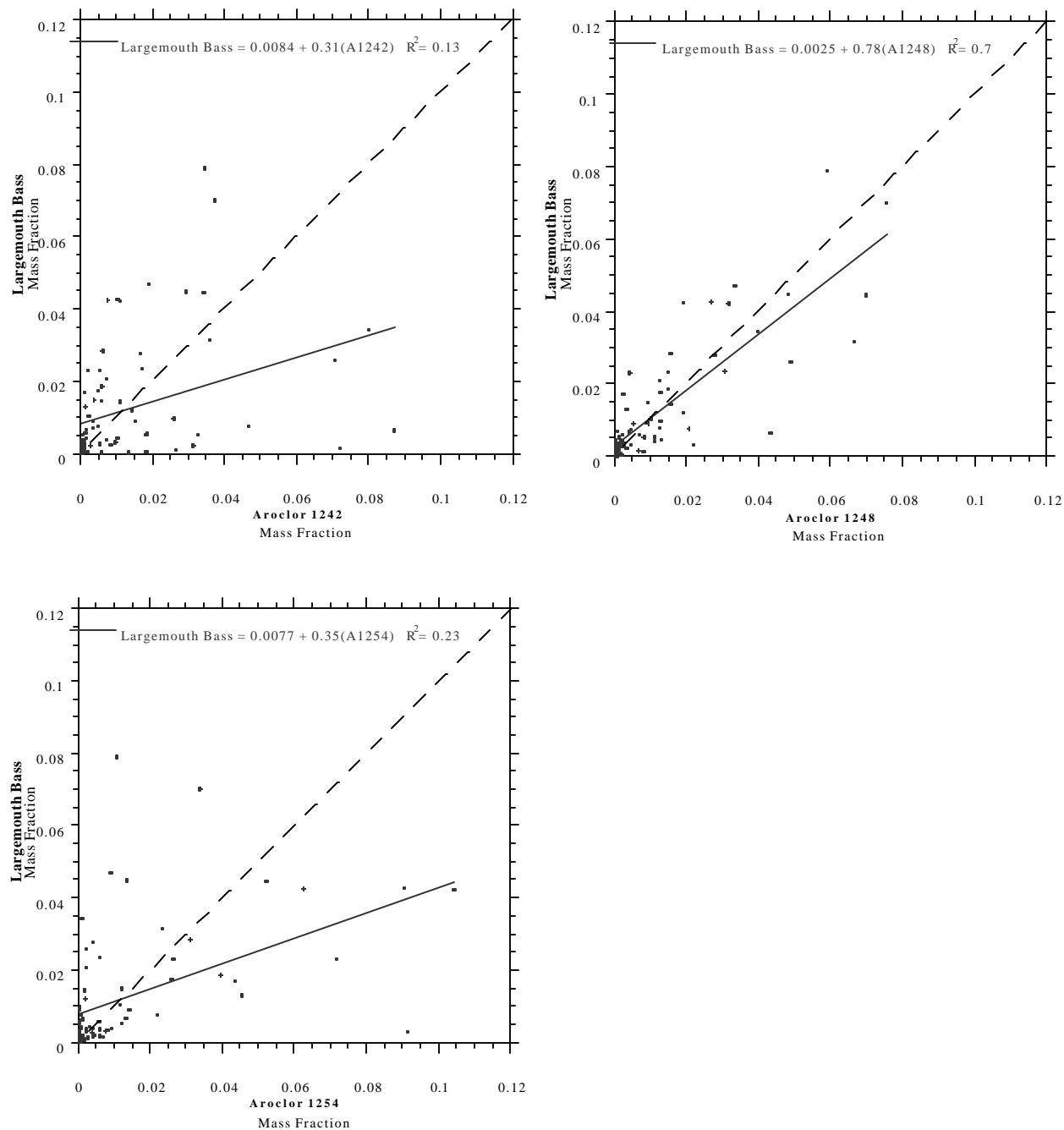


**Figure 3-4: Cumulative Distribution Functions of Exposure for Kingfisher and Eagle**



**Figure 3-5: Cumulative Distribution Functions of Exposure for Mink and Otter**



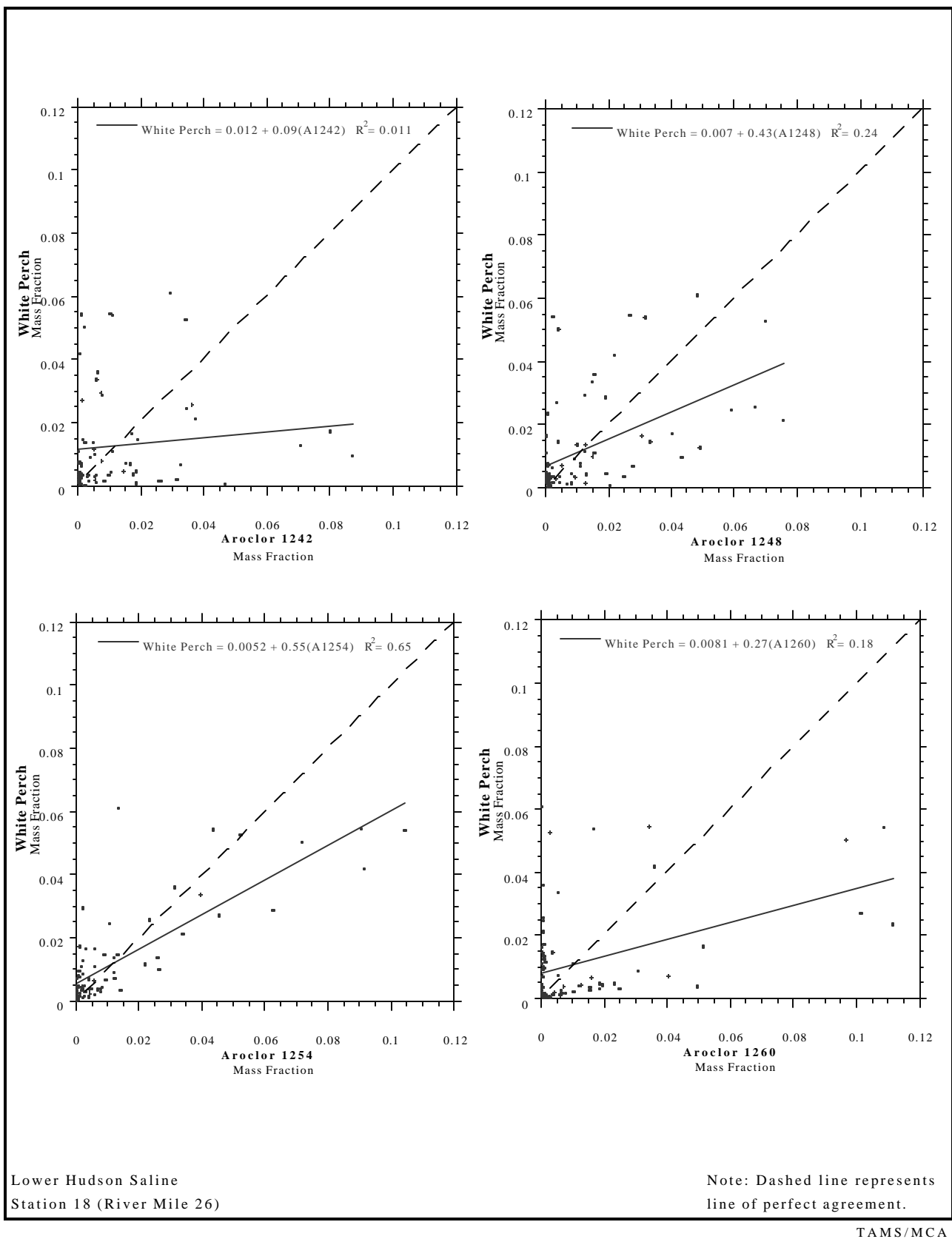


Upper Hudson  
Station 4 (River Mile 190)

Note: Dashed line represents  
line of perfect agreement.

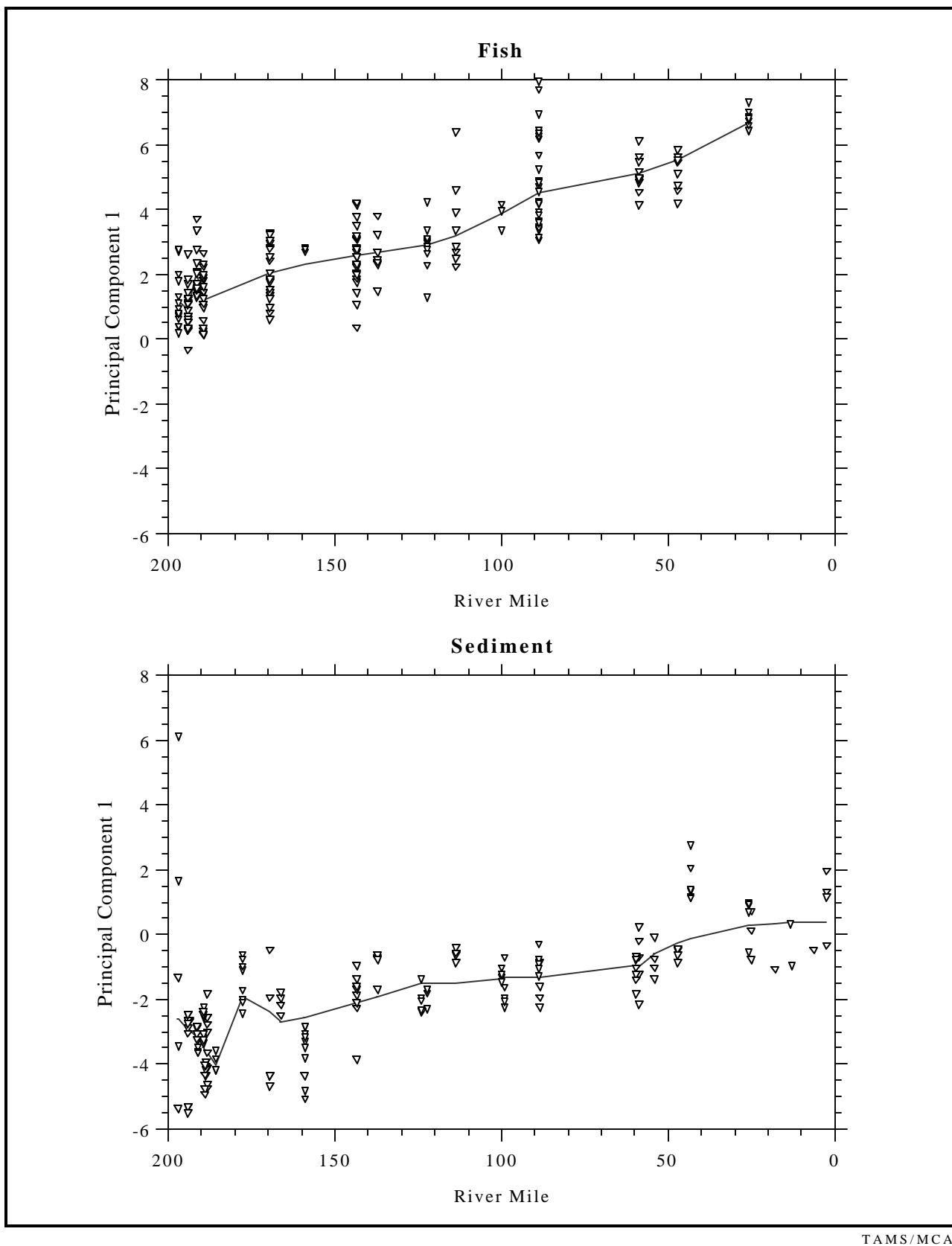
TAMS/MCA

**Figure 3-6**  
**Comparison of Congener Mass Fraction Between a Large Mouth Bass Sample from RM 190 and Several Aroclor Standards**



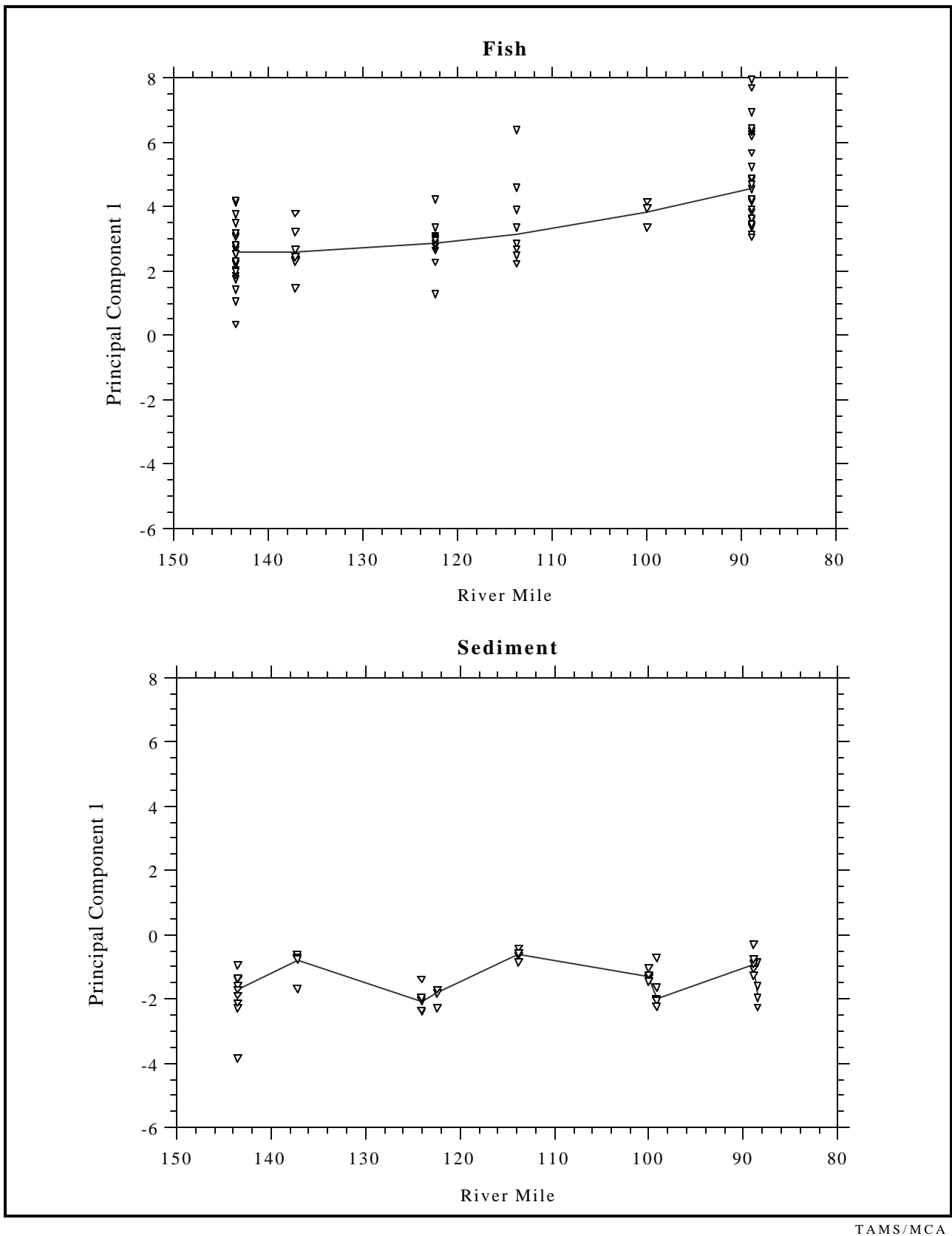
**Figure 3-7**  
**Comparisons of Congener Mass Fraction Between a White Perch Sample from RM 26 and Several Aroclor Standards**





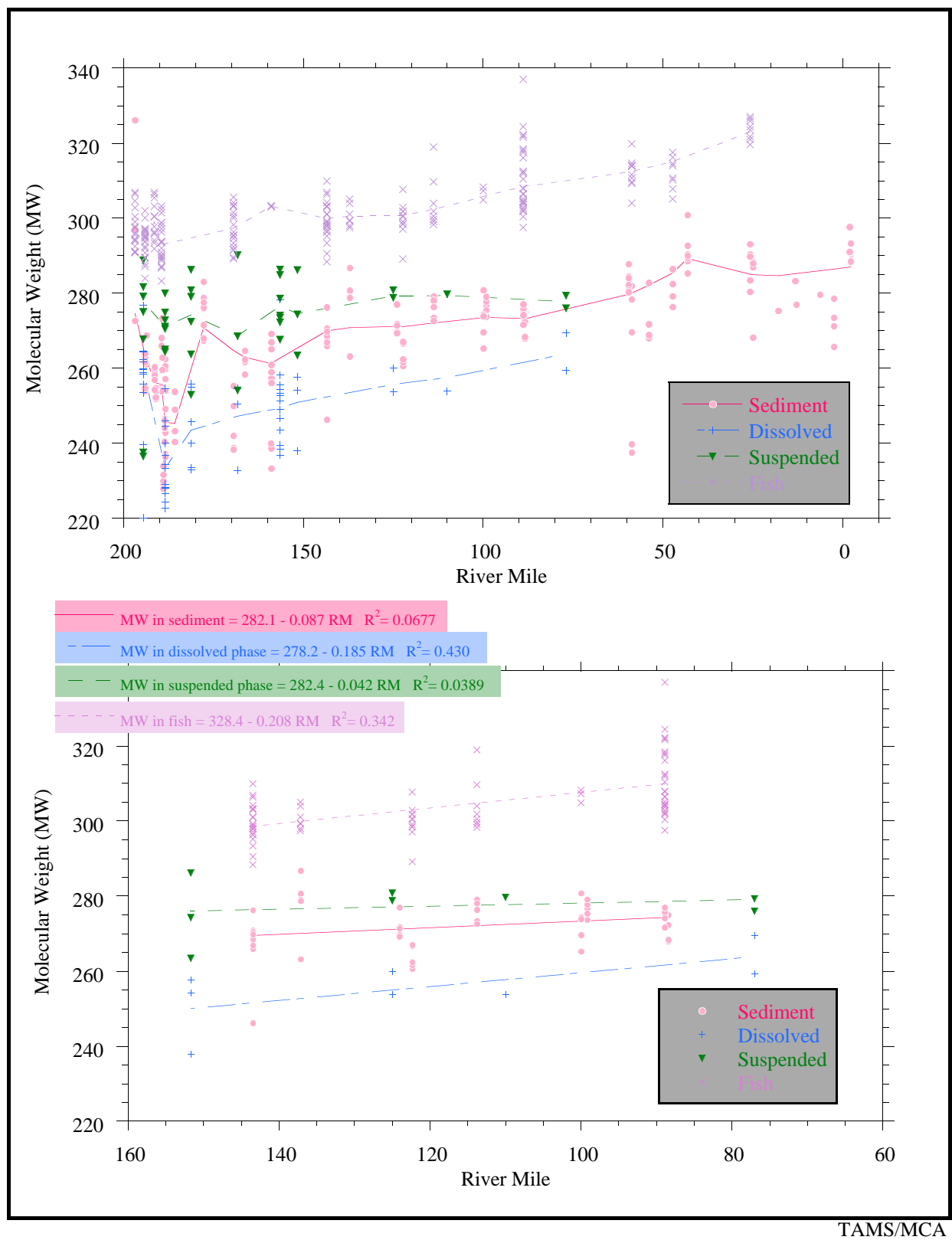
TAMS/MCA

**Figure 3-8**  
**Variation of Principal Component 1 with River Mile in Fish and Sediment**

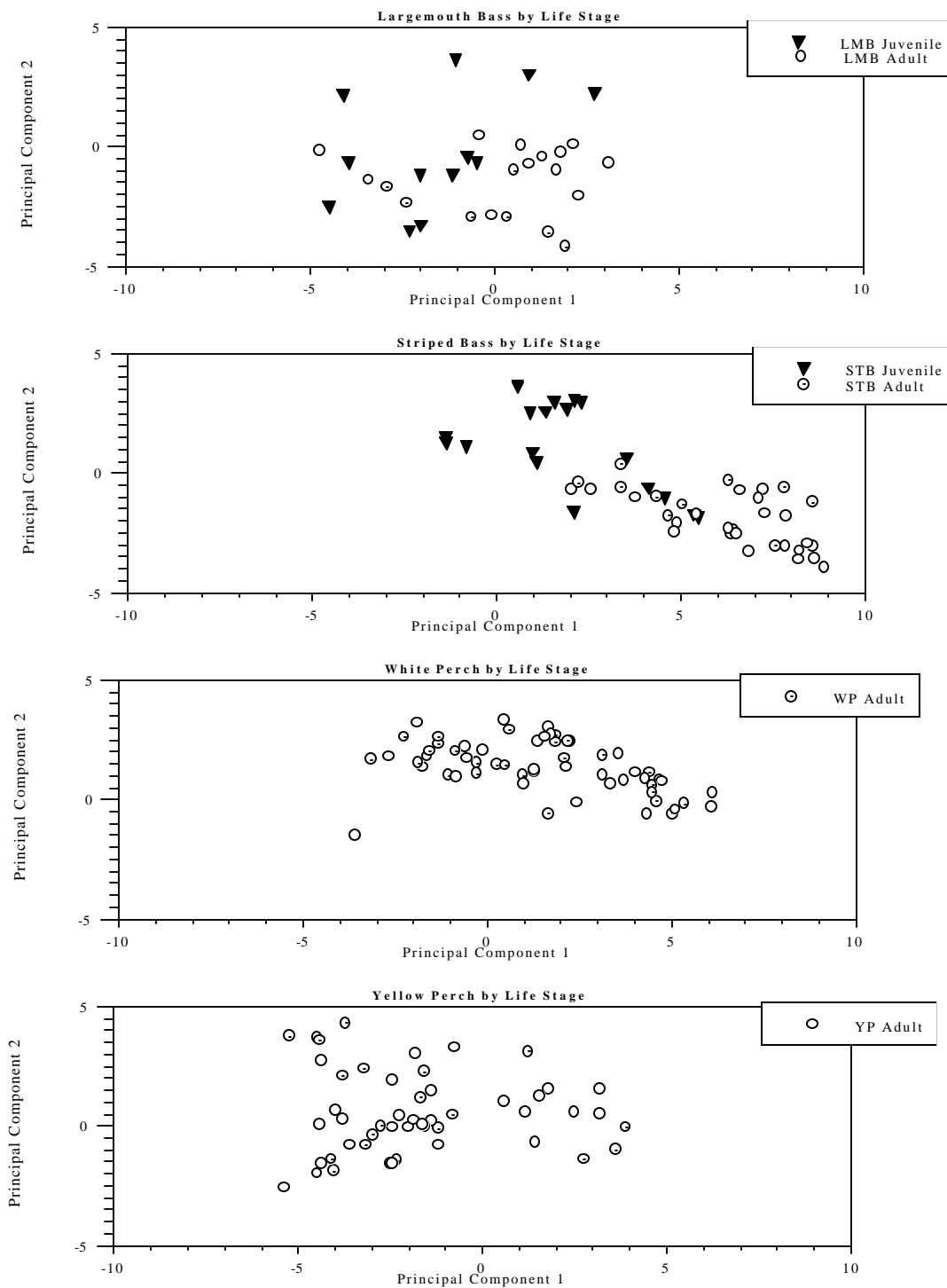


TAMS/MCA

**Figure 3-9**  
**Variation of Principal Component 1 with River Mile in Fish and**  
**Sediment River Miles 150 to 80**



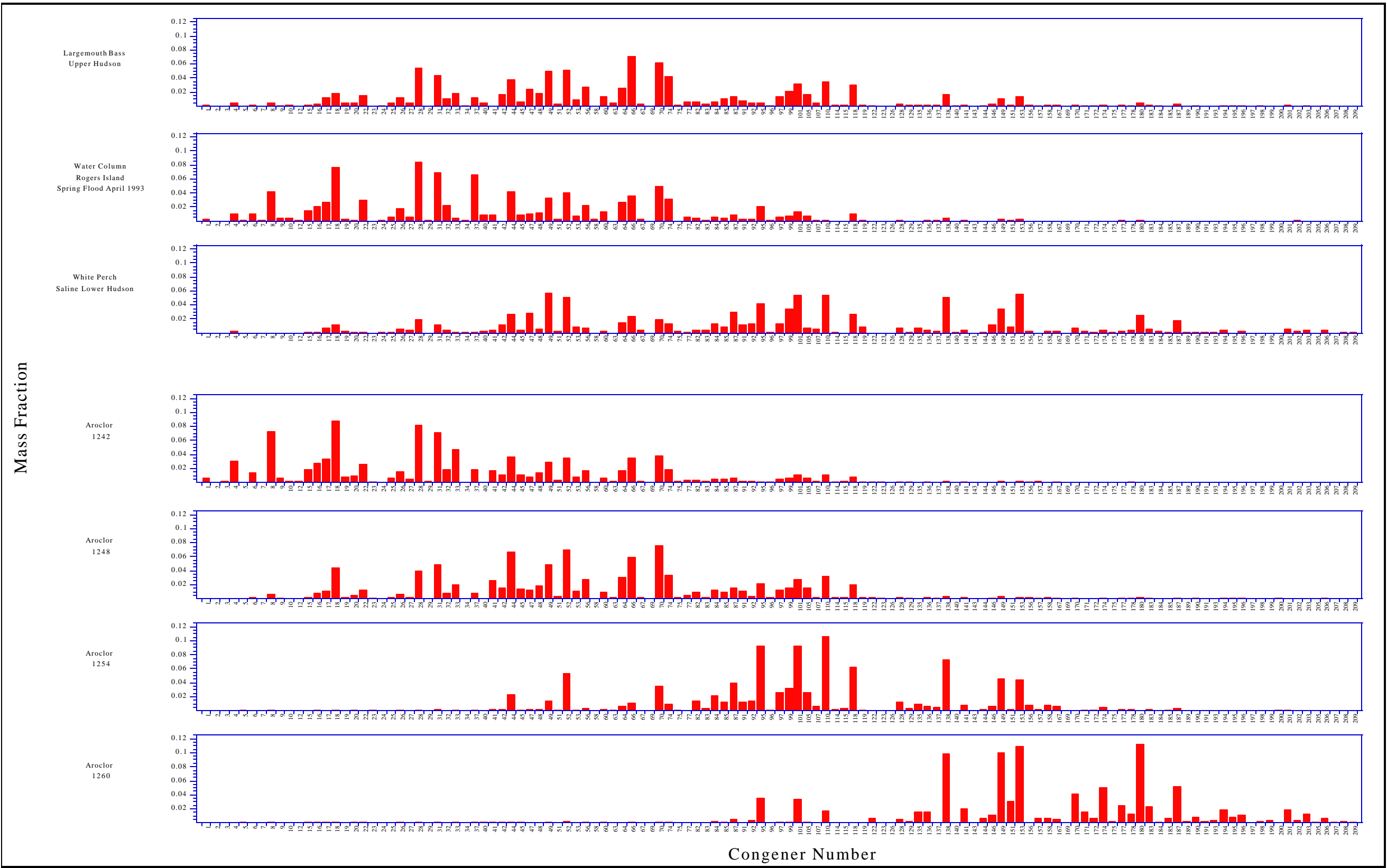
**Figure 3-10**  
**Comparison Between Molecular Weight and River Mile**  
**for 1993 Hudson River Samples**



Note: 1993 USEPA and NOAA Fish Data and 1995 NOAA Fish Data  
316 Samples (Eleven 1995 Samples Omitted, NOAA, 1997)

TAMS/MCA

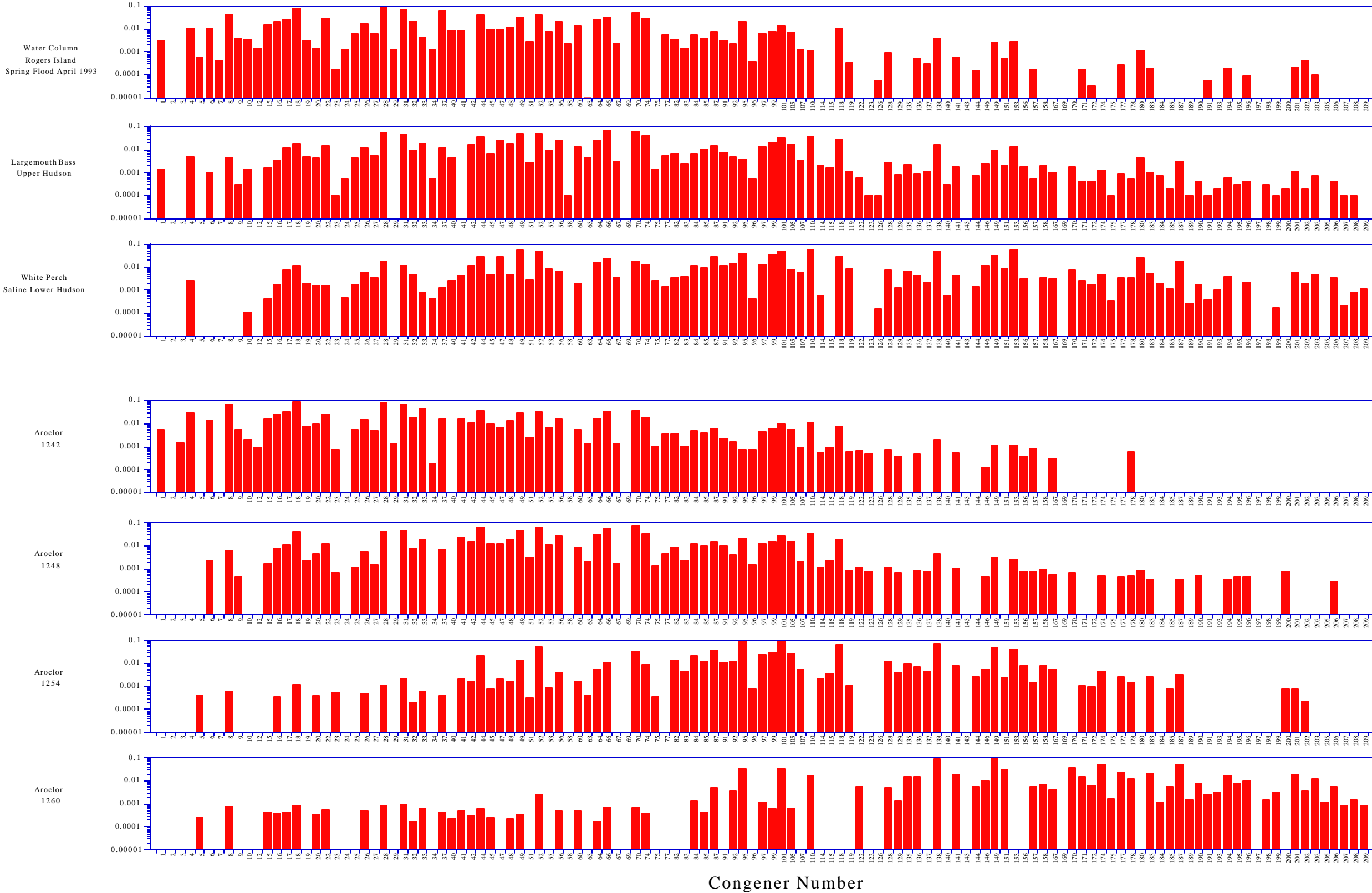
**Figure 3-11**  
**Principal Component Results for 1993 and 1995**  
**Fish Samples by Life Stage**  
**(Based on 29 Congeners)**



TAMS/MCA

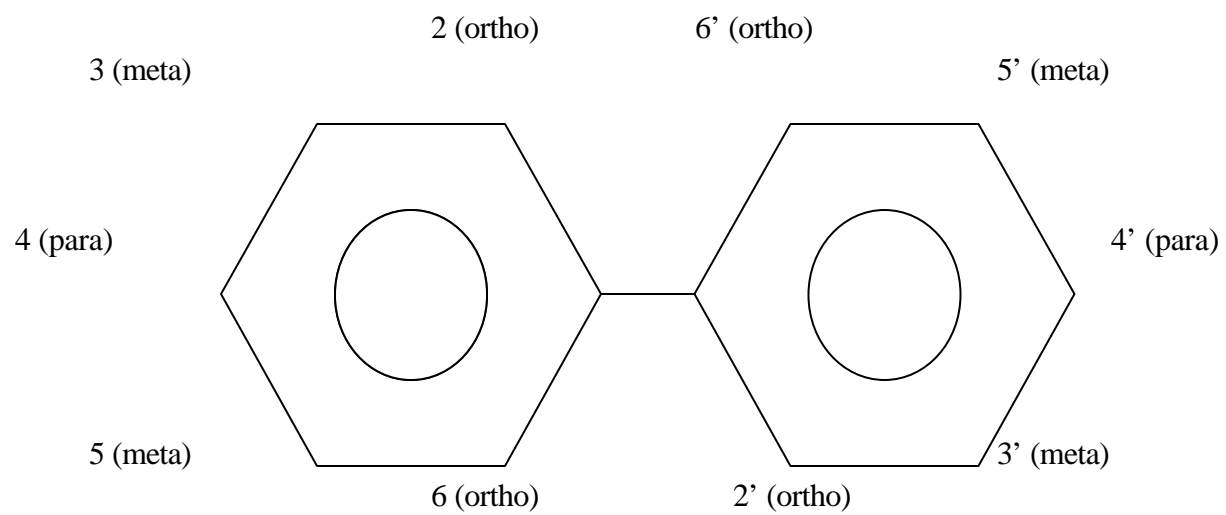
Figure 3-12  
Comparison of Congener Mass Fraction in Hudson River Fish and Several Aroclor Standards: Linear Scale

Mass Fraction



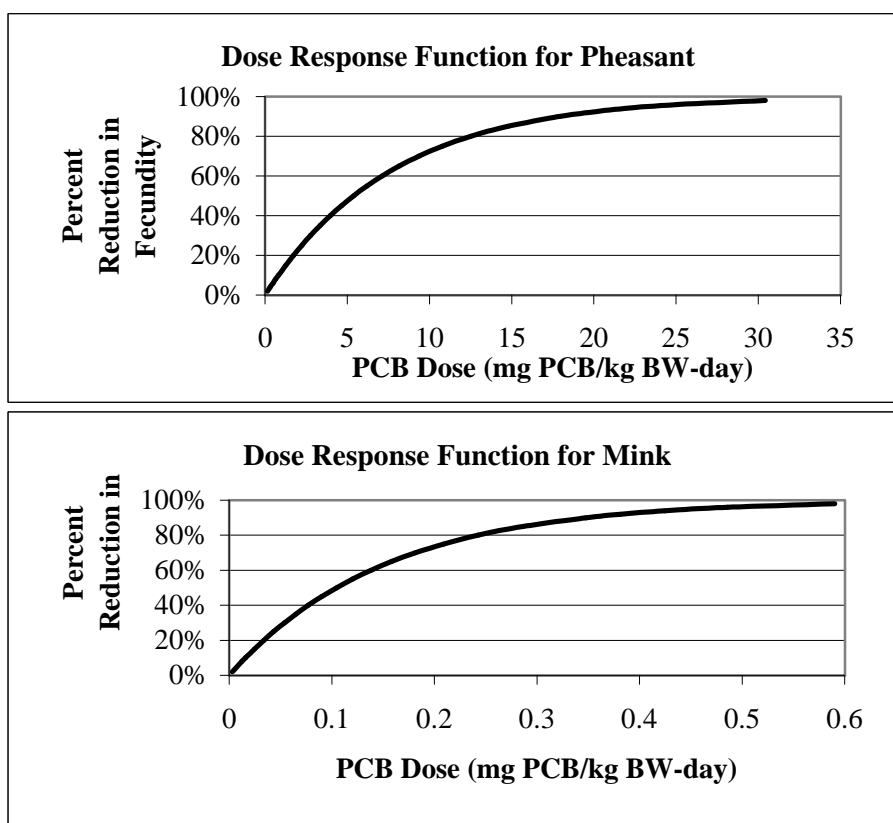
TAMS/MCA

**Figure 3-13**  
**Comparison of Congener Mass Fraction in Hudson River Fish and Several Aroclor Standards: Semilogarithmic Scale**

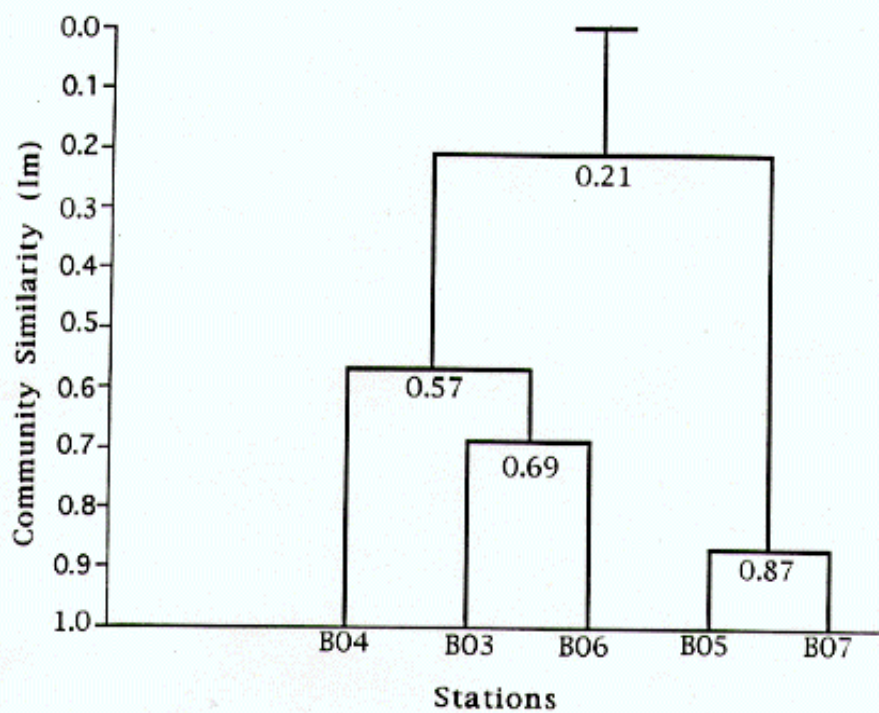


**Figure 4-1: Shape of Biphenyl and Substitution Sites**

**FIGURE 4-2: Dose Response Functions for Pheasant and Mink**

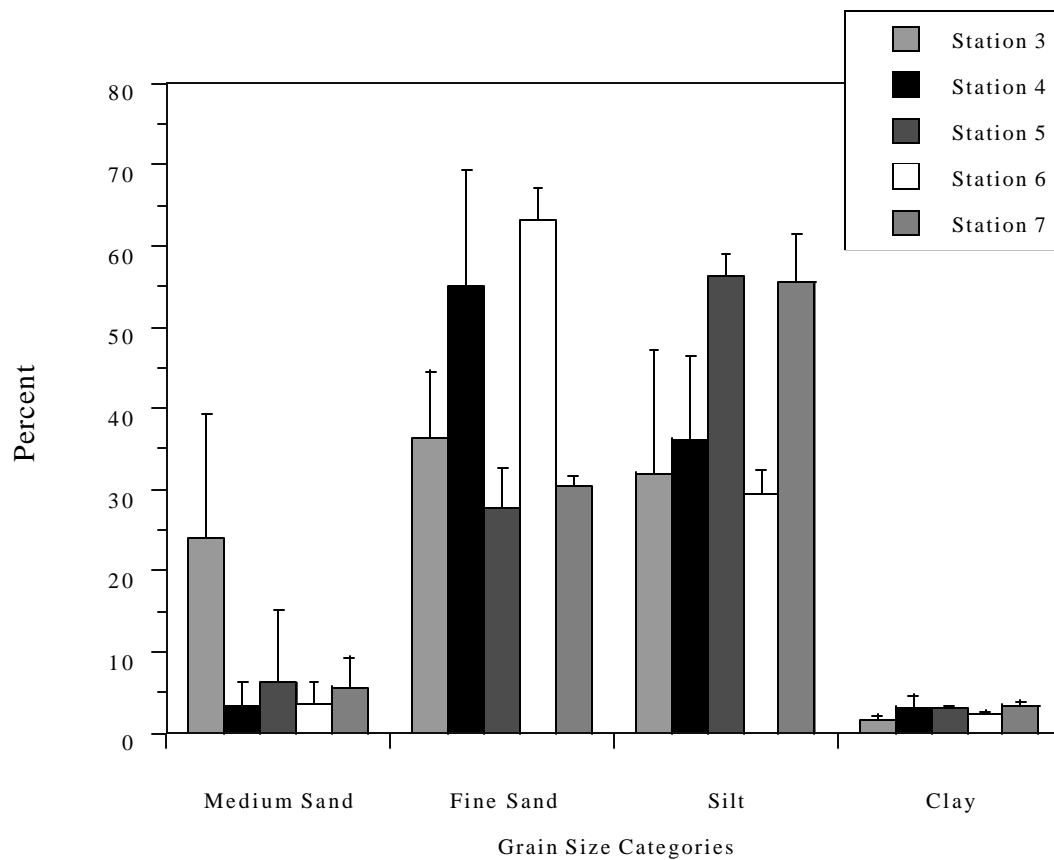






Note: The dendrogram is based on Morista's Index ( $I_m$ ) of community similarity and the computed fusion value of each junction is given.

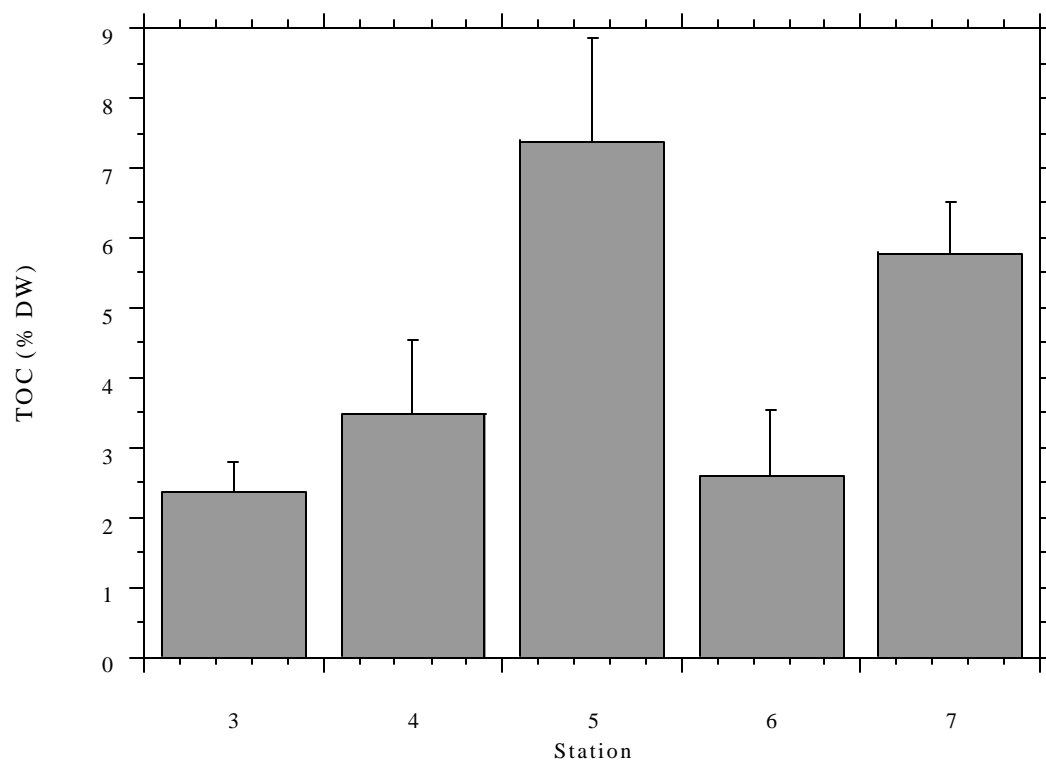
**Figure 5-1**  
**Complete Linkage Clustering - TI Pool**



Note: Error bars represent one standard deviation.

TAMS/MCA

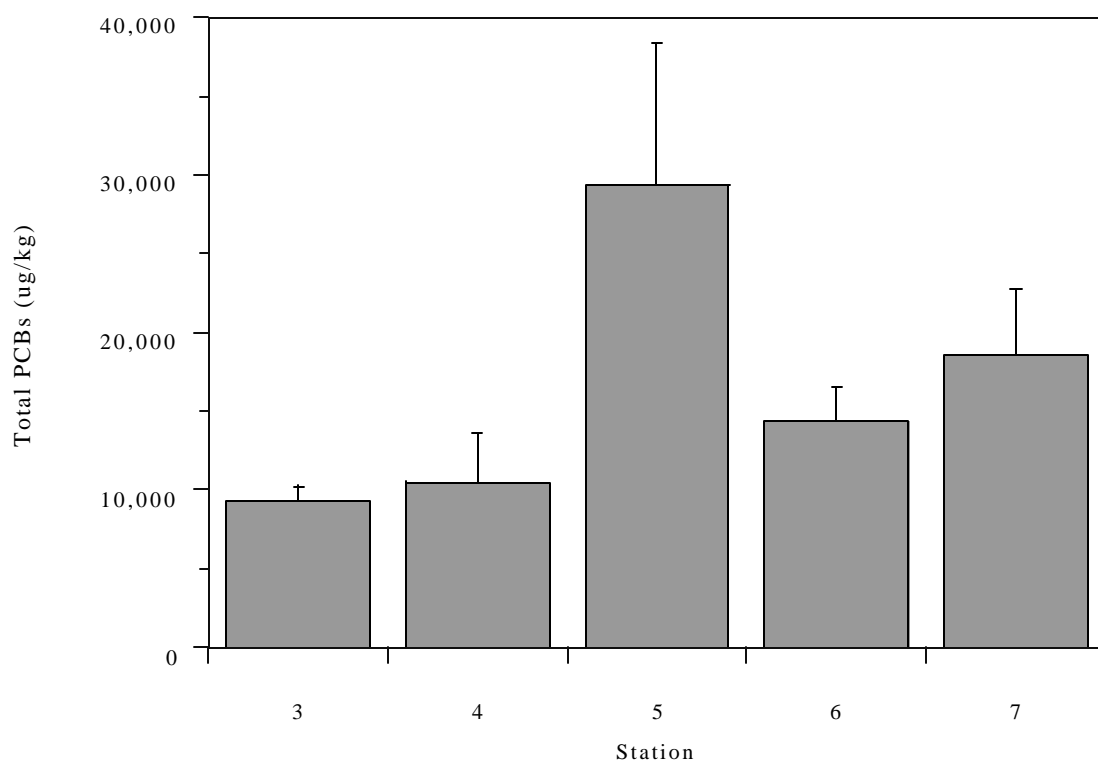
**Figure 5-2**  
**Relative Percent Grain Size Classes - TI Pool**



Note: Error bars represent one standard deviation.

TAMS/MCA

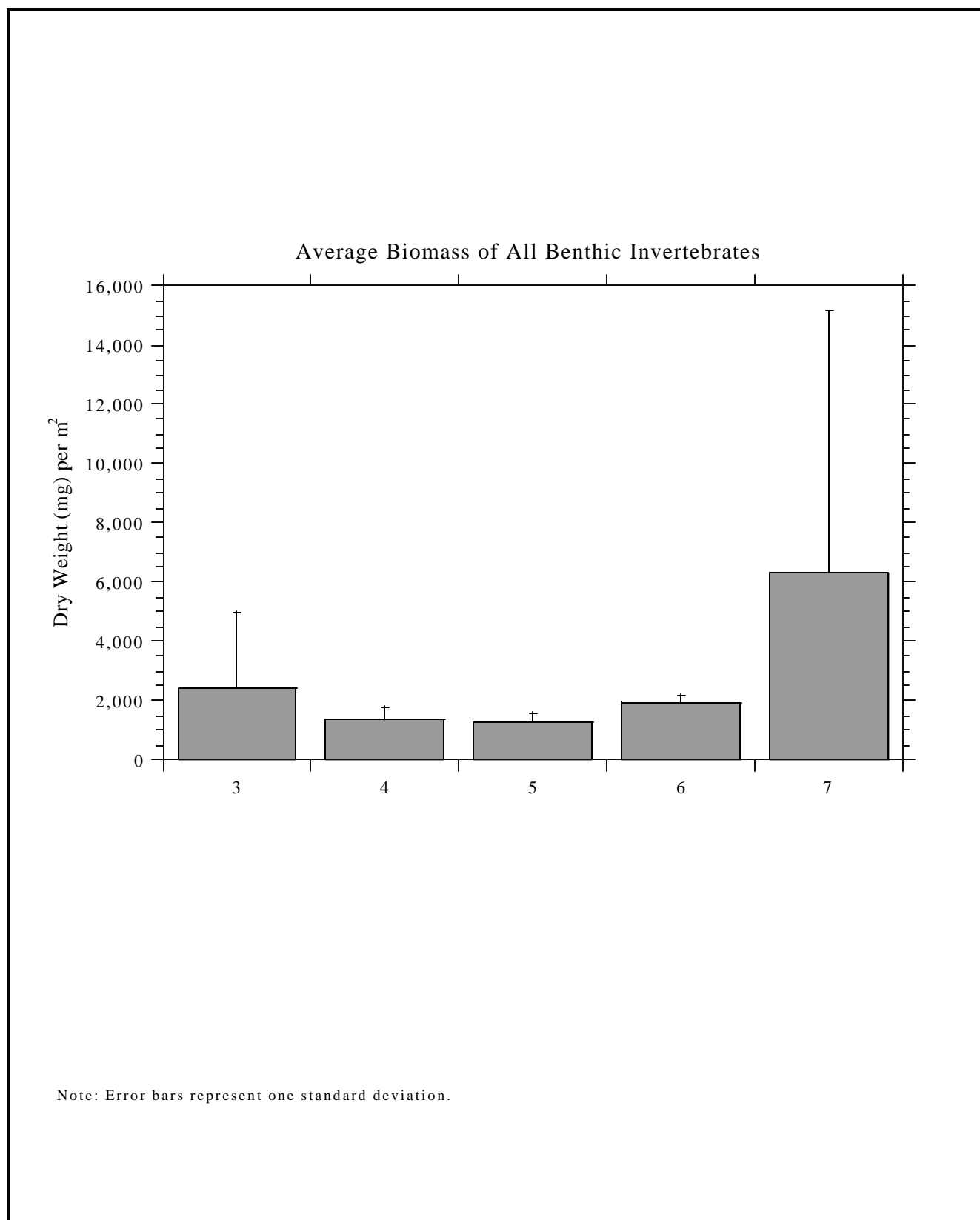
**Figure 5-3**  
**Mean Sediment TOC - TI Pool**



Note: Error bars represent one standard deviation.

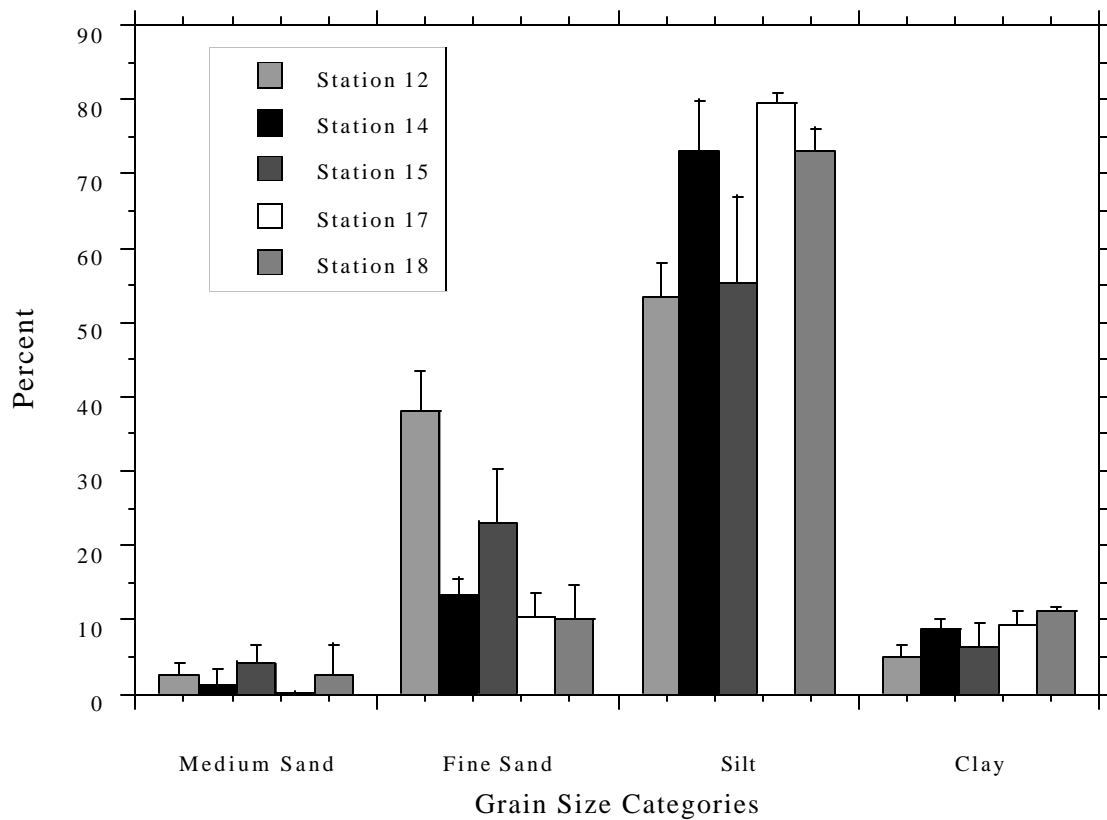
TAMS/MCA

**Figure 5-4**  
**Mean Total PCB Concentration in Sediment - TI Pool**



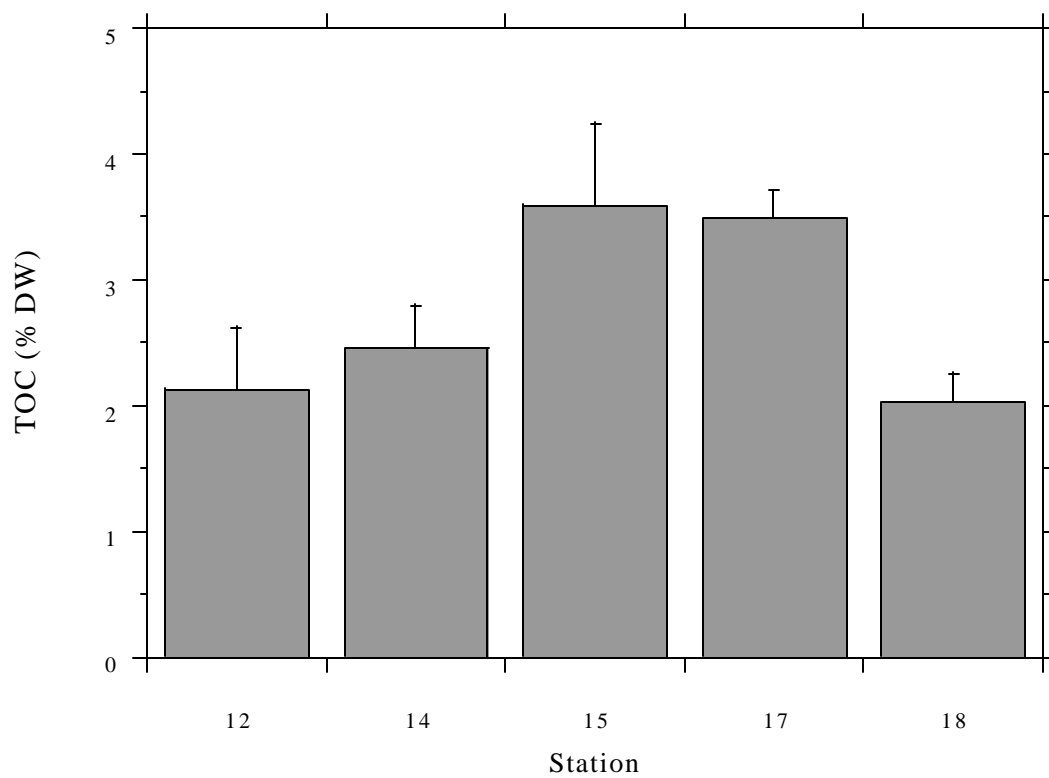
TAMS/MCA

**Figure 5-5**  
**Biomass of Benthic Invertebrates - TI Pool**



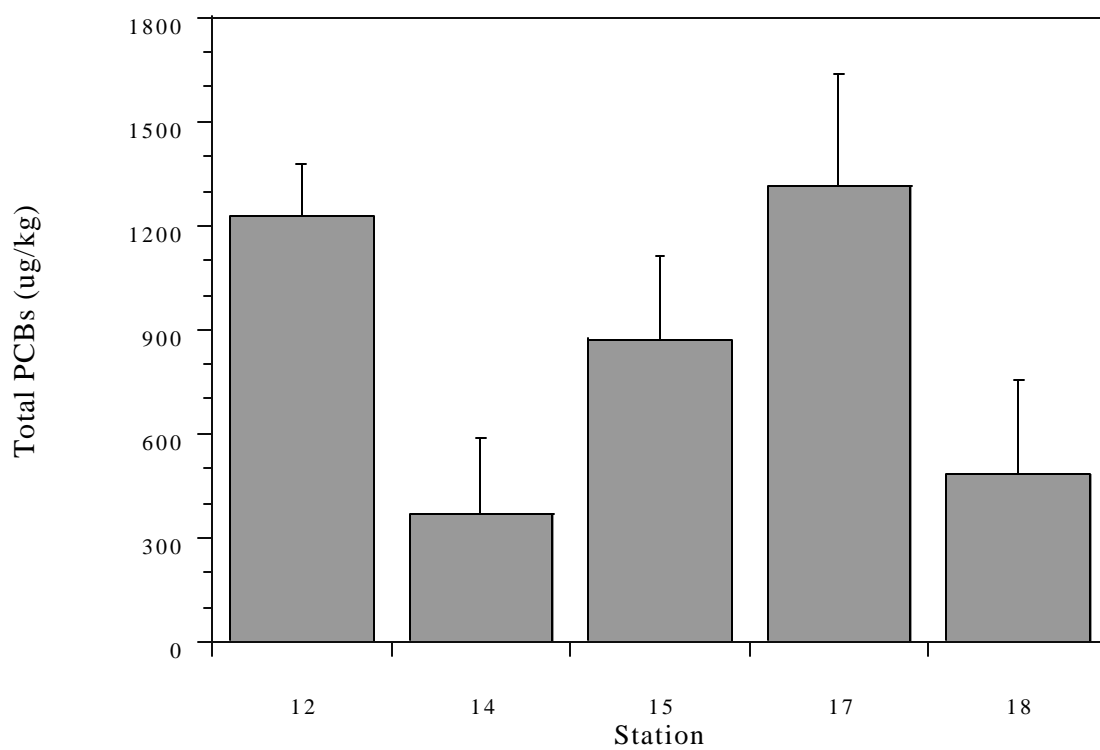
TAMS/MCA

**Figure 5-6**  
**Relative Percent Grain Size Classes - Lower Hudson River**



TAMS/MCA

**Figure 5-7**  
**Mean Sediment TOC - Lower Hudson River**



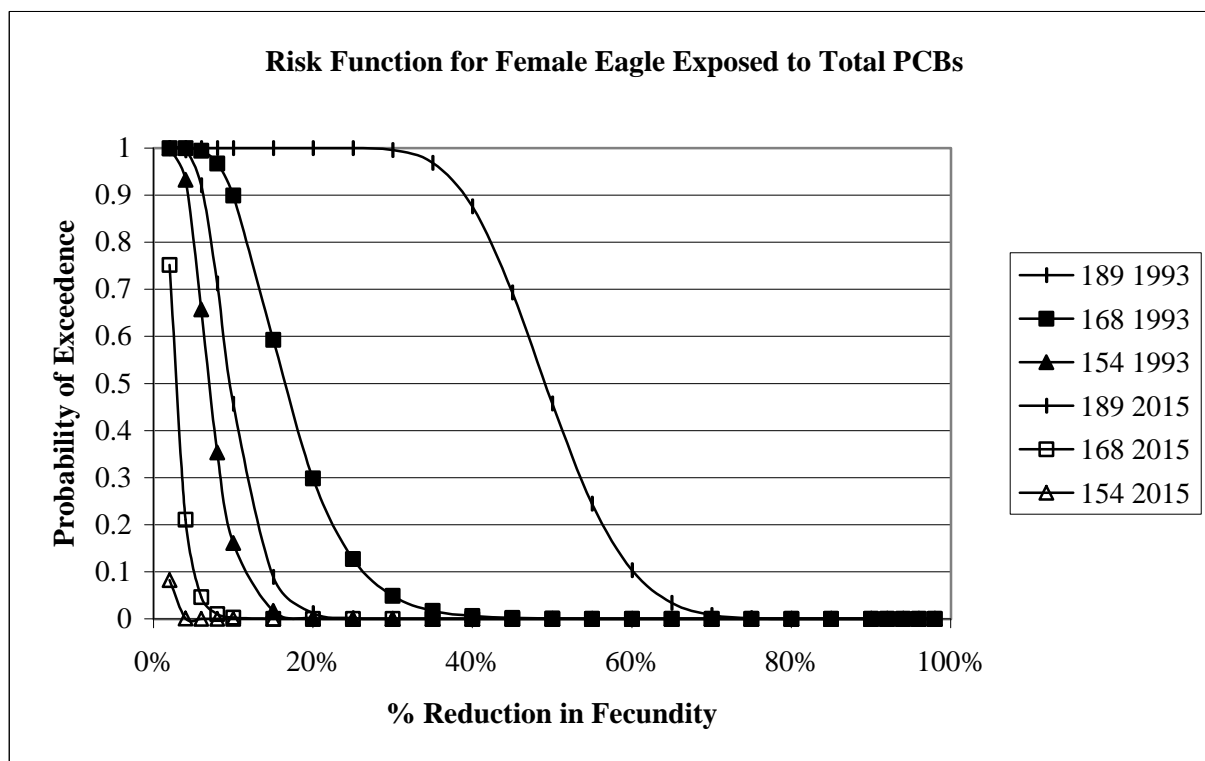
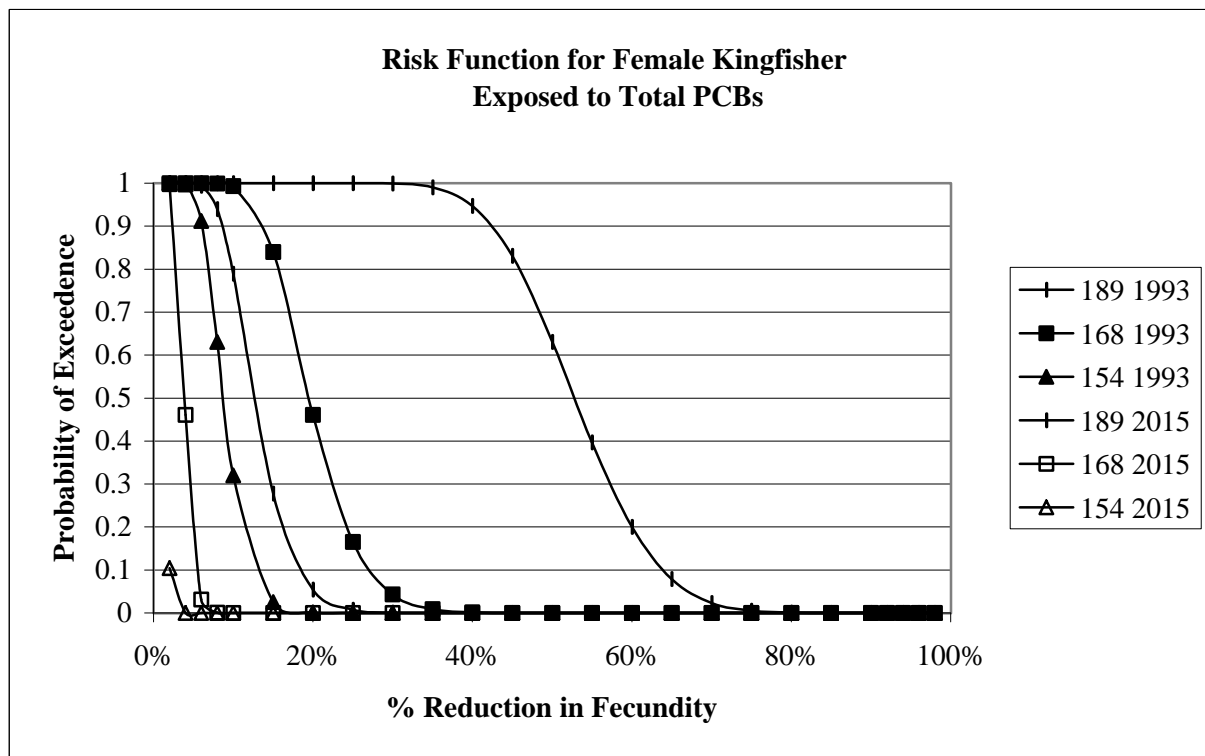
Note: Error bars represent one standard deviation.

TAMS/MCA

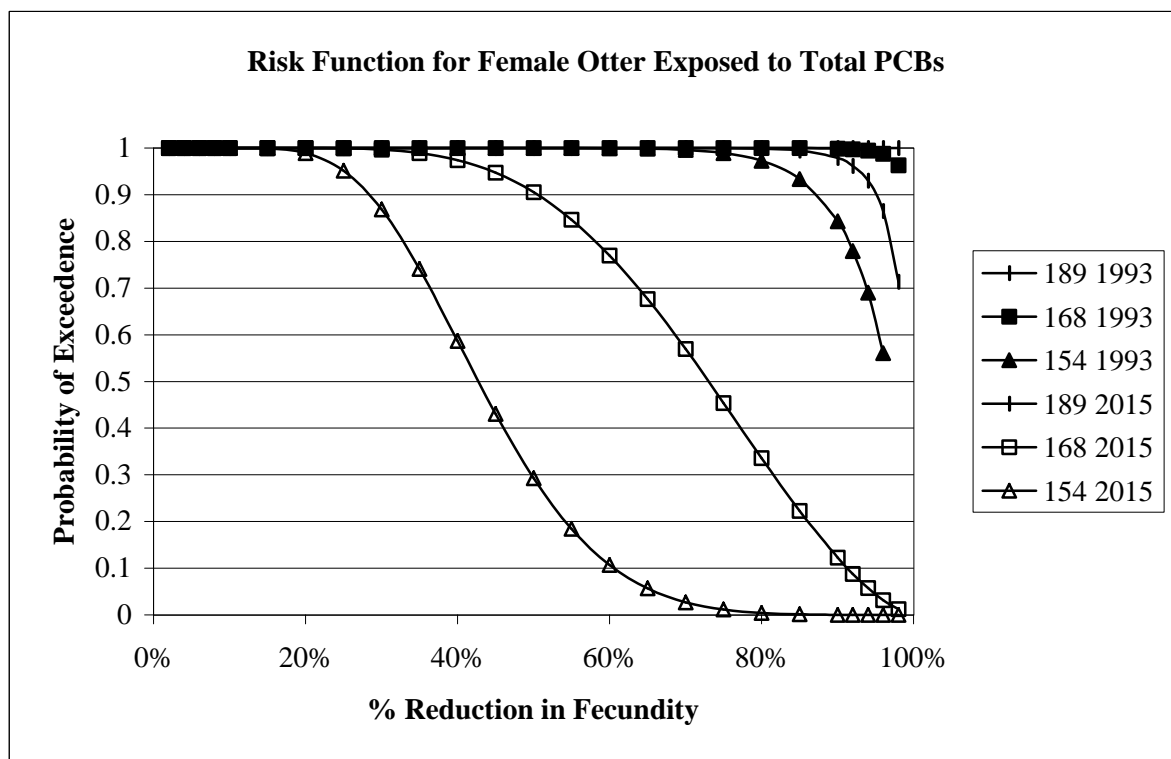
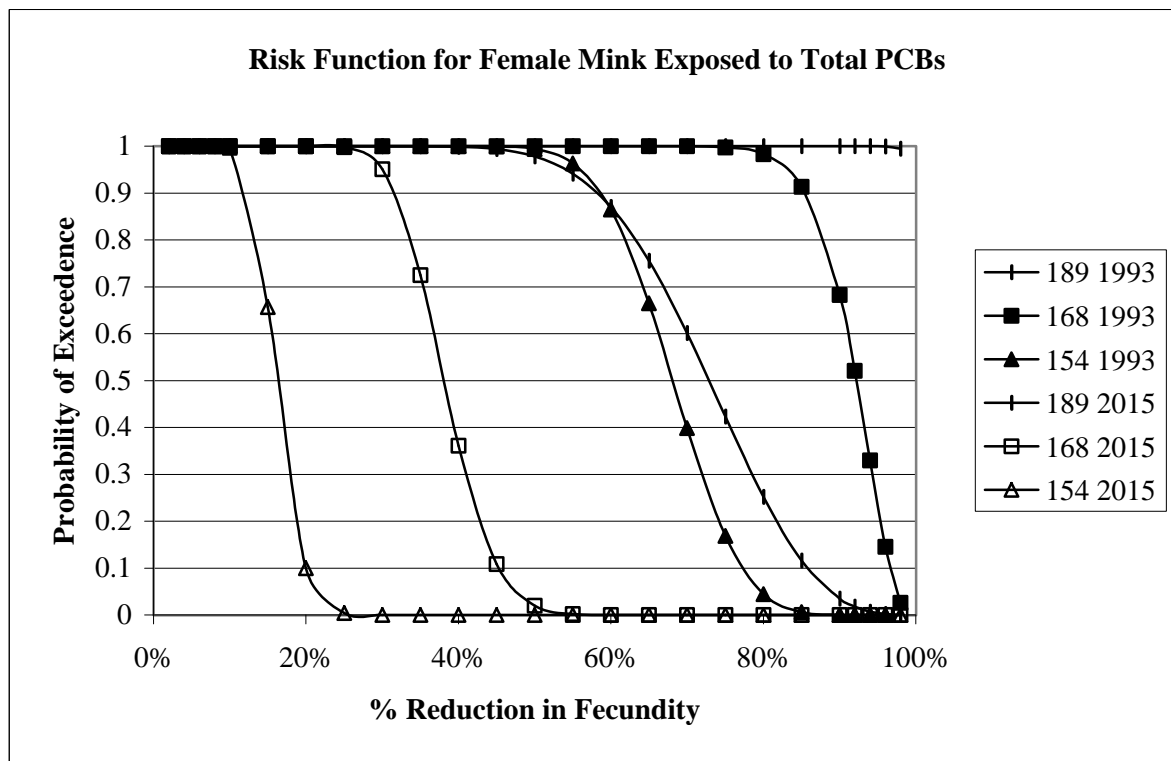
**Figure 5-8**  
**Mean Total PCB Concentration in Sediment - Lower Hudson River**



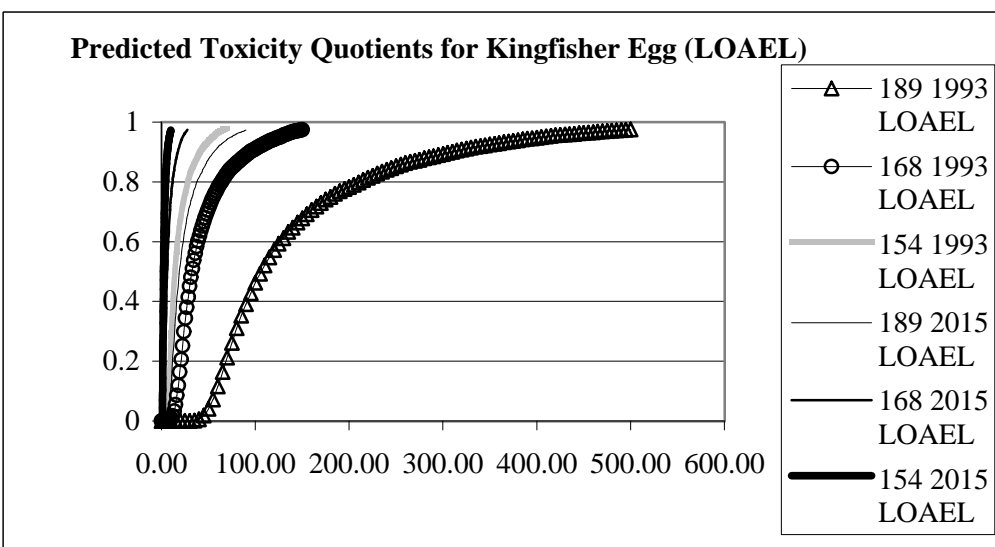
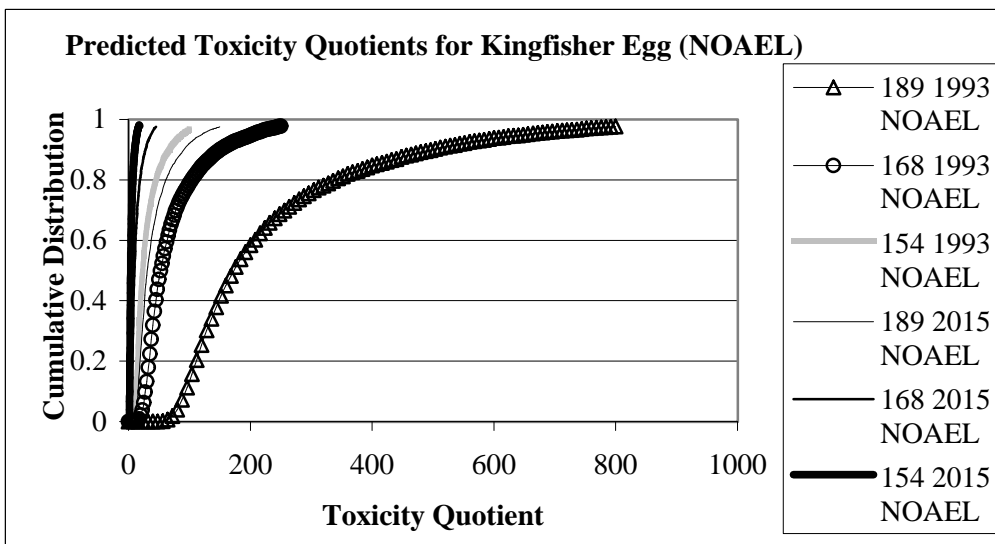
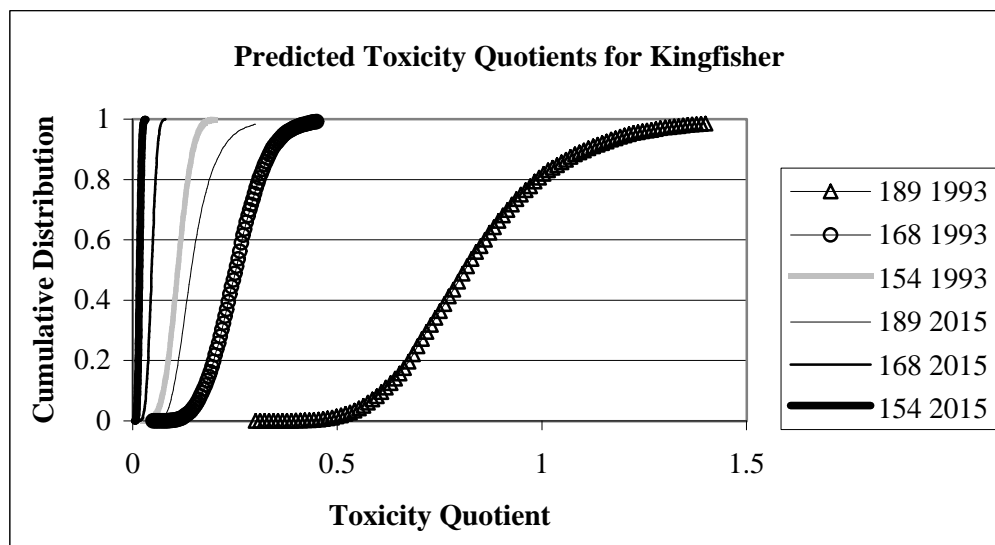
**Figure 5-9: Cumulative Risk Functions for the Belted Kingfisher and Bald Eagle**



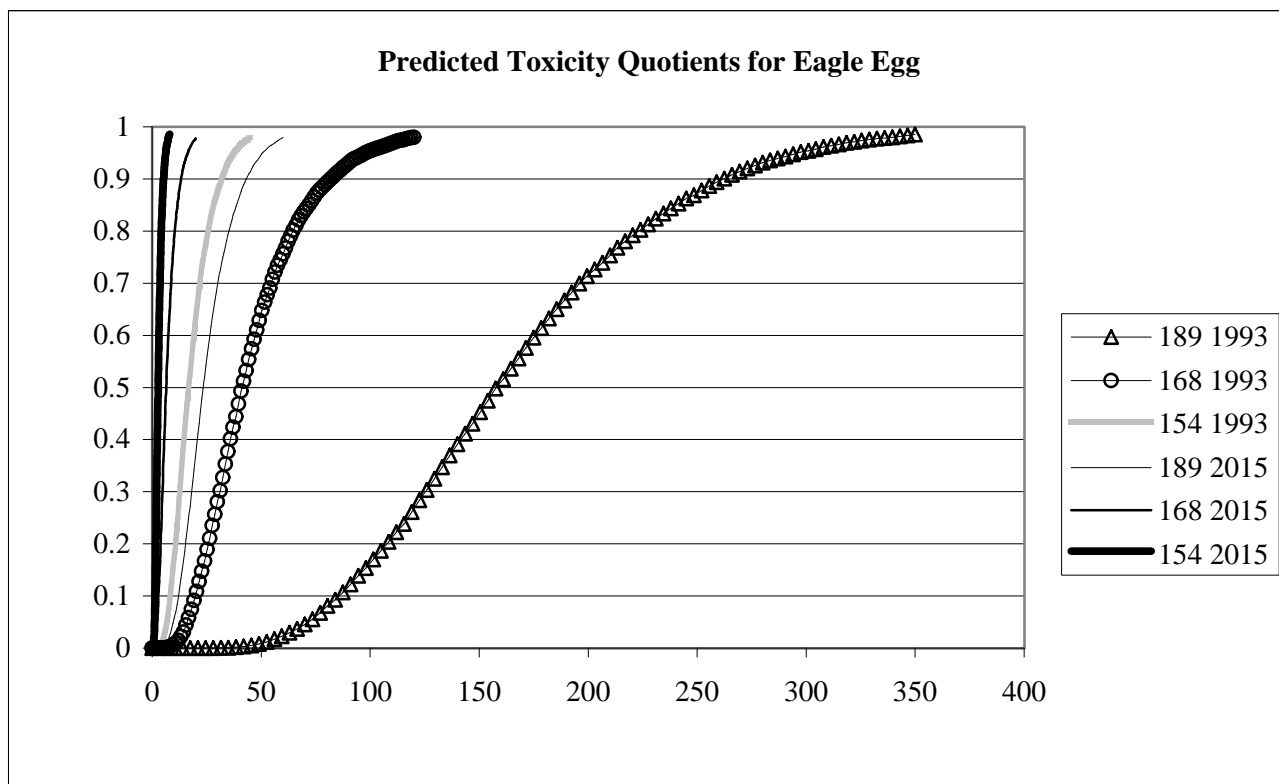
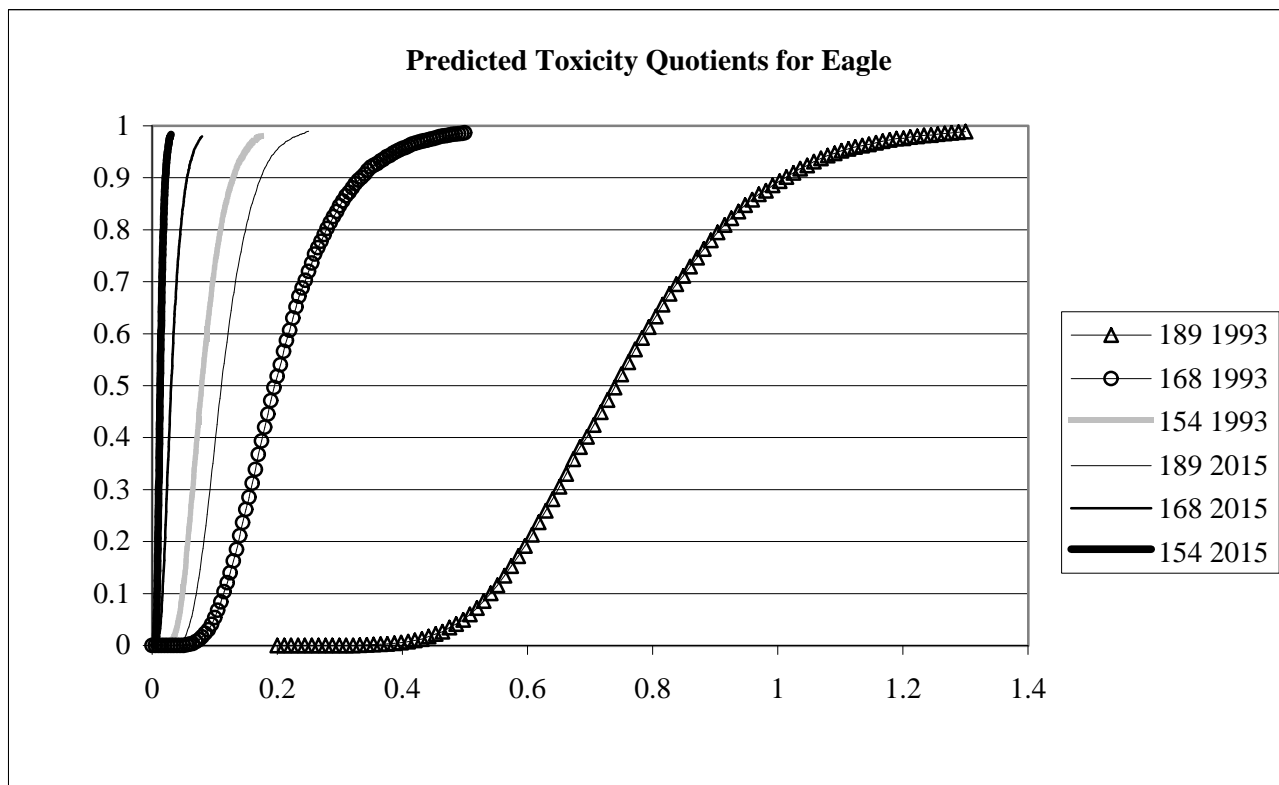
**Figure 5-10: Cumulative Risk Functions for Mink and River Otter**



**FIGURE 6-1: Predicted Toxicity Quotients from Uncertainty Analysis  
for Kingfisher and Kingfisher Egg**



**FIGURE 6-2: Predicted Toxicity Quotients from Uncertainty Analysis  
for Eagle and Eagle Egg**



**FIGURE 6-3: Predicted Toxicity Quotients from Uncertainty Analysis  
for Mink and Otter**

